

FEASIBILITY STUDY

I-40 EXPRESS LANES from I-85 to WADE AVENUE ORANGE, DURHAM, AND WAKE COUNTIES

Divisions 5 and 7
FS-1205A

Prepared For:



Feasibility Studies Unit
Division of Planning and Programming
North Carolina Department of Transportation

Documentation Prepared By:

Atkins

DocuSigned by:
Clinton J. Morgan
7D3B8F44C08543A...

Clinton J. Morgan, P.E.
Project Manager
Atkins

DocuSigned by:
Derrick Lewis
9ED3BDDA931B400...

Derrick W. Lewis, P.E.
Feasibility Studies Unit Head
Feasibility Studies Unit

DocuSigned by:
Lynnise Hawes
DC64C38D85234F8...

Lynnise M. Hawes, P.E.
Feasibility Studies Engineer
Feasibility Studies Unit

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1 General Description

The project is located in Orange, Durham, and Wake Counties, North Carolina Department of Transportation (NCDOT) Highway Divisions 5 and 7. The project location is shown on **Figure 1**. The proposed project will incorporate managed lanes along I-40. The improvements will consider the option of one or two managed lanes in each direction with the option for future light rail and bus rapid transit considerations. The study area includes approximately 30 miles of I-40, with direct connections at nine locations.

Two alternative concepts were selected to be further evaluated at a functional design level for this feasibility study. This feasibility study evaluates the potential impacts associated with the two selected alternatives for the I-40 improvements to include one or two managed lanes in each direction. The two alternatives are as follows:

1. I-40 with One Managed Lane Each Direction
2. I-40 with Two Managed Lanes Each Direction

2 Purpose of This Study

This feasibility study is a preliminary step proceeding the planning and design process for this project, and is not to be considered the product of exhaustive environmental or design investigations. The purpose of this study is to describe the transportation issue including proposed project cost, develop and evaluate alternatives at a screening level, recommend an alternative, and identify potential impacts to the human and natural environment that may require consideration in future planning and design phases.

If a candidate project is identified for funding in the State Transportation Improvement Program (STIP), the Feasibility Study is followed by a rigorous planning and design process that meets the requirements of the National Environmental Policy Act (NEPA), where, if required, an Environmental Impact Statement (EIS) or an Environmental Assessment (EA) is done.

3 Project Need

The primary need for this project is to improve traffic flow and reduce traffic congestion along the I-40 corridor. I-40 runs approximately 420 miles through the state of North Carolina from the Tennessee state line in the west to its eastern terminus in Wilmington.

During the last few decades the Research Triangle region of North Carolina has experienced significant growth in both population and employment. This growth has dramatically increased travel demand along the I-40 corridor. Existing traffic congestion within the I-40 corridor results in unpredictable delays, as well as excessive travel times for commuters and travelers. Predicted growth in the Triangle Region will increase these delays and travel times.

The purpose of the proposed action is to provide immediate relief by improving travel time reliability within the study area by the project's opening and design year. To achieve this, it is proposed to incorporate managed lanes with value pricing within the project corridor. This approach will address travel delays and congestion by providing a transportation option that results in more reliable trip times and improves overall network efficiency.

4 Crash Analysis

A crash analysis was performed to compare crash rates within the study area to other urban interstates in North Carolina, as well as determine the types of crashes and identify crash hot spots. The Traffic Engineering Accident Analysis System's Strip Analysis Report was provided by NCDOT and was used to evaluate the existing traffic crash rates on I-40 between milepost 7.43 (I-85) and milepost 36.64 (Harrison Avenue). Five years of crash history data, from January 1, 2010 to December 31, 2014, were analyzed.

Crash rates were determined based on methodologies from NCDOT Traffic Survey Unit's *Guideline for Utilizing NC Statewide Crash Rates*. For each freeway segment, the critical crash rate was calculated using the statewide crash rate with a 95% confidence interval. The critical crash rate is a statistically derived value against which a calculated rate can be compared to see if the rate is above an average far enough so that something besides chance must be the cause. A safety ratio was calculated for each segment by dividing the critical crash rate by the actual crash rate. Poor/critical segments were identified as having a safety ratio less than one.

A summary comparison of the crash rates on I-40 within the study area versus the average crash rate for all urban interstates within North Carolina is presented in **Table 1**. I-40 has a substantially higher rate of total crashes than the average rate for all North Carolina urban interstates. The safety ratio was less than one for non-fatal injury crashes, night crashes, property damage only crashes, and wet crashes. However, this section of I-40 has a substantially lower rate of fatal crashes and run off the road crashes compared to all urban interstates in North Carolina.

Table 1: I-40 Study Area Crash Rates

Segment	Number of Crashes	Actual Crash Rate	Statewide Crash Rate	Critical Crash Rate	Safety Ratio
Total	4,929	156.70	89.93	96.23	0.61
Fatal	14	0.40	0.34	0.80	2.00
Non-Fatal Injury	919	29.20	22.16	25.33	0.87
Property Damage Only	3,996	127.10	67.43	72.90	0.57
Night	1,375	43.70	19.94	22.95	0.53
Wet	1,136	36.10	23.65	26.92	0.75
Run-Off-Road	393	12.50	22.35	25.53	2.04

During the five-year reporting period, there were a total of 4,929 crashes of various types within the I-40 corridor. The three most common types of crashes were rear end, fixed object and sideswipe. These three types of crashes make up nearly three-quarters of the total crashes, with rear end crashes the most common type making up almost half of the total crashes on I-40.

Within the study area, using the existing interchange structures as dividing points, the I-40 corridor was broken down into segments to identify areas with high total crash rates. The statewide average total crash rate for all urban interstates is 89.93 crashes per 100 million vehicle miles travel (NCDOT Traffic Safety Unit's *2010-2012 North Carolina Crash Rates*). The crash rate analysis by segment, summarized in **Table 2**, indicates that 12 of the 16 segments (75%) have a higher actual rate of total crashes than the critical crash rate. The four segments with an actual crash rate below the critical crash rate were located in the western portion of the study area where the interchange spacing is greater and volumes are lower.

Table 2: I-40 Crash Rates by Segment

Segment	Length	AADT ¹	Number of Crashes	Actual Crash Rate	Critical Crash Rate	Safety Ratio
I-85 to Old NC 86	2.70	59,000	160	110.10	120.58	1.10
Old NC 86 to New Hope Church Road	2.10	66,000	83	65.60	122.92	1.87
New Hope Church Road to NC 86	3.02	69,000	197	103.60	116.54	1.12
NC 86 to US 15-501	4.06	74,000	343	125.10	111.91	0.89
US 15-501 to NC 54	2.79	88,000	228	101.80	114.35	1.12
NC 54 to NC 751	1.49	114,000	300	193.60	119.56	0.62
NC 751 to Fayetteville Road	1.41	111,000	307	215.00	120.87	0.56
Fayetteville Road to NC 55	2.35	119,000	449	176.00	112.75	0.64
NC 55 to NC 147	1.17	119,000	316	248.70	122.84	0.49
NC 147 to Davis Drive	0.95	146,000	265	209.40	122.91	0.59
Davis Drive to Miami Boulevard	0.70	152,000	248	255.40	127.91	0.50
Miami Boulevard to Page Road	0.78	162,000	218	189.10	124.58	0.66
Page Road to I-540	0.72	169,000	298	268.40	125.29	0.47
I-540 to Airport Boulevard	1.27	142,000	284	172.60	118.64	0.69
Airport Boulevard to Aviation Parkway	1.20	139,000	297	195.10	119.85	0.61
Aviation Parkway to Harrison Avenue	2.50	159,000	936	258.10	108.93	0.42

1. Volumes based on NCDOT's Traffic Survey Group 2013 Interstate & Freeway Report (<http://www.ncdot.gov/projects/trafficsurvey/download/NCDOT2013InterstateFreewayReport.pdf>).

5 Alternatives

Thirteen interchange concepts (Appendix-A) were evaluated as part of this feasibility study to include conceptual alternatives for the preferred alternative. Alternative 1 is an interim phase for Alternative 2 which would be the ultimate build out. While Alternative 1 only constructs one managed lane in each direction it does provide space for a second lane to be built in the median. An alternative development meeting was held to discuss the conceptual designs with various NCDOT representatives. A qualitative process was used to evaluate social and environmental

impacts, traffic operations, and construction cost to select up to two (2) Alternative concepts to be further developed to a functional design level and are described below. The roadway typical section along I-40 for the proposed managed lanes are provided in **Figure 2**, one managed lane each direction and **Figure 2A**, two managed lanes each direction.

5.1 Alternative 1 I-40 with One Managed Lane Each Direction

Alternative 1 is the phased approach to incorporate one managed lane in each direction along I-40. This alternative accommodates managed lanes from the I-85/I-40 interchange split in Orange County to the Wade Avenue Interchange in Wake County. This alternate will provide one managed lane each direction in the median or to the side of existing I-40.

The alternative to add one additional lane in each direction meets the goal to improve traffic efficiency and reduce congestion along I-40. Improvements that would be made to I-40 interchange access with the option of one managed lane are listed in **Table 3**.

5.2 Alternative 2 I-40 with Two Managed Lanes Each Direction

Alternative 2 is the ultimate condition that incorporates two managed lanes in each direction along I-40. This alternative accommodates two managed lanes each direction from the I-85/I-40 interchange split in Orange County to the Wade Avenue Interchange in Wake County. This alternate will provide two managed lanes in the median or to the side of existing I-40.

The alternative to add two additional lanes in each direction meets the goal to improve traffic efficiency and reduce congestion along I-40. Improvements that would be made to I-40 access with the option of two managed lanes are similar to Alternative 1 and are listed in **Table 3**. The proposed design for the ultimate condition of two managed lanes each direction is provided in **Appendix A**.

Table 3: I-40 Access Improvements with Managed Lanes

I-40 Access Location	Improvements	Managed Lane Access
NC 86	Button hook design which elevates the median slip ramp up to an elevated structure spanning the west bound side of I-40.	Direct access to I-40 for traffic coming to and from the east.
US 15-501	Button hook design located to the west of US 15-501.	Access provided by crossing over the westbound lanes and connecting to Mount Moriah

I-40 Access Location	Improvements	Managed Lane Access
		Road behind the shopping center.
NC 751	Raised connection to Renaissance Parkway between NC 751 and Fayetteville Road, (See Figure 6A of 10) or the alternate design connecting by button hook west of NC 751 to either Southpoint Autopark Boulevard. (See Figure 6 of 10)	Direct access connection to NC 751 or Renaissance Parkway depending on the alternate.
NC 147	Circular free flow interchange for express lanes (halo interchange).	All direct access movements accommodated on an elevated circular roadway.
Miami Boulevard	Button hook interchange configuration east of Miami Boulevard connecting to Old Page Road.	Direct access to Miami Boulevard.
I-540	Circular free flow interchange for express lanes (halo interchange).	All direct access movements accommodated on an elevated circular roadway.
Aviation Parkway	Button hook concept west of the existing interchange that will connect to Aviation Parkway across from National Guard Drive.	Direct access connection to Aviation Parkway
Old Reedy Creek Road	Old Reedy Creek Road will be redesigned as an express lane only interchange.	Direct access for express lanes from Old reedy Creek road to I-40.
North Harrison Avenue	Button hook concept just east of the interchange that would connect in the northeast quadrant north of the quarry road.	Direct access to North Harrison Avenue.

Additional Information

Our Transit Future is the study of regional rail transit investment opportunities within a corridor study area that spans Orange, Durham and Wake counties. On-going planning and project development provide comprehensive analysis of new rail corridors and existing bus operations to enhance mobility, capacity, and connectivity. Triangle Transit, the authority behind Our Transit Future, operates regional bus and shuttle service, paratransit services, and ridematching for car and vanpools. Triangle Transit works closely with municipal governments and their transportation providers (below), the area's Metropolitan Planning Organizations (MPOs), and various federal and state agencies in future planning considerations for the region. NCDOT will contact Go Triangle during later planning and design phases to coordinate regional transit projects proposed within the study area.

Light Rail Transit (LRT) is used to provide high frequency rail transit service. Stations in the urban core are spaced less than a mile apart and farther apart in suburban areas. Market forces respond to high frequency peak, off-peak and weekend LRT service. LRTs may operate in roadway medians, in lanes adjacent to one or both sides of the street, or in exclusive rights-of-way. LRT considerations along the project corridor would provide additional commuter services and potentially reduce the amount of traffic along the I-40 corridor study area. A LRT station is proposed along the I-40 corridor easement, further coordination with NCDOT will be required as the project moves forward.

Bus Rapid Transit (BRT) is a bus-based mass transit system. A BRT system has a specialized design, services, and infrastructure to improve system quality and remove the typical causes of bus delay. BRT aims to combine the capacity and speed of a light rail or metro system with the flexibility, cost and simplicity of a bus system. BRT considerations along the project corridor would provide additional commuter services and could potentially operate within one dedicated lane. This option would require additional evaluation as an option to reduce traffic for commuters in the region. BRT uses a range of vehicles including typical transit buses, specially designed modern buses and elongated flexible (articulated) buses.

Bus on Shoulder System (BOSS) is in use along both directions of Interstate 40 from U.S. 15-501 in Durham County to Wade Avenue in Wake County. The operating rules for the NC Pilot Program allow authorized transit buses to operate in the shoulder. NC BOSS pilot segments have been identified for westbound I-40 (NC 147 to US 15-501) and eastbound I-40 (US 15-501 to Page Road). Information on BOSS obtained from triangletransit.org/boss.

Figure 3 identifies the future transit projects discussed above that have the potential of being incorporated along the I-40 widening corridor project area.

6 Transportation Plans and Local Input

6.1 NC Transportation Improvement Program

The feasibility study to construct managed lanes along I-40 from NC 86 in Orange County to State Route 1728 (Wade Avenue) in Wake County is included in the current *North Carolina State Transportation Improvement Program (STIP) 2016-2025*. Planned transportation improvement projects along the project corridor are listed below in **Table 4**:

Table 4: STIP Projects

STIP Project Number	Project Location and Description
FS-1205	NC 86 in Orange County to SR 1728 (Wade Ave) in Wake County, construct managed lanes.
I-0305	I-85 Corridor Improvement.
I-3306	Add additional lanes to I-40 from I-85 to the Durham County Line.
I-3306 A	I-40 widening from I-85 in Orange County to the Durham County Line.
U-3306	NC 86 TO SR 1734 (Erwin Road) in Chapel Hill, corridor upgrade.
U-4763	New Route - Triangle Parkway, McCrimon Parkway to I-40 in Research Triangle Park and Morrisville, multi-lane facility on new location.
I-5506	SR 1002 (Aviation Parkway) Interchange, Construct Loop Ramp in northwest quadrant.
U-5324	NC 54, I-40 To NC 55 in Durham. Widen to multi-lanes with transit accommodations, bike lanes, and sidewalks.
U-5517	NC 54, SR 1110 (Farrington Road) to I-40 eastbound entrance ramp in Durham. Construct a slit ramp.
I-5702	US 15 / US 501 in Durham County to I-440 / US 64 in Wake County. Construct Managed Lanes.
I-5702 A	US 15 / US 501 to NC 147. Widen Existing Roadway
I-5702 B	NC 147 (Durham Freeway / Triangle Expressway) in Durham County to SR 1728 (Wade Ave) in Wake County. Widen Existing Roadway

6.2 Local Transportation Plans

2040 Metropolitan Transportation Plans for the Capital Area Metropolitan Planning Organization (CAMPO) and the Durham-Chapel Hill-Carrboro Planning Organization (DCHC MPO) identify improvements to I-40 in the long range plans for each MPO. The plan includes road improvements for I-40 and interchange upgrades along the project corridor.

6.3 Input from Local Officials

The City of Durham, Town of Chapel Hill, Town of Cary, Town of Morrisville, Orange County, Capital Area Metropolitan Planning Organization (CAMPO), and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC-MPO) were present at the Design Review Meeting, November 5, 2014 to provide comments about this project. Local officials present at the meeting are in favor of the project with a majority of the comments in respect to direct access connections from proposed interchanges and improvements to incorporate the managed lanes along the project corridor.

7 Existing Conditions

The existing conditions section of this report evaluate current land use and economic development, travel patterns, roadway/transit facilities constraints, and environmental characteristics within the I-40 study area. I-40 is the region's primary interstate used by commuters to access Raleigh, Durham and Chapel Hill. The I-40 interstate highway passes through the Research Triangle area which is the home of many businesses and educational institutions. Travel lanes in Orange County and Durham County vary from two to three lanes to the Durham-Chapel Hill metropolitan area where the lanes increase to handle the traffic demand through the Triangle Region to Wade Avenue.

The population of the Triangle Region is predicted to more than double over the next 30 years. Between 2000 and 2010, the population of Durham-Chapel Hill metropolitan area increased by 18 percent and Raleigh by 42 percent (www.census.gov). The increasing trend in population growth continues to contribute to increased traffic congestion and is more evident year by year, particularly in the peak commute periods. Land use within the project includes right of way for the existing I-40 interstate corridor and 11 interchanges with a mix of residential, commercial, industrial and forested land.

8 Traffic Analyses

The year 2040 traffic forecast was provided by the NCDOT Transportation Planning Branch for use with this project. AM and PM peak hour volumes were developed from the traffic forecast using NCDOT Congestion Management Section’s Intersection Analysis Utility (IAU) tool for two-way volumes. Volume adjustments were required using engineering judgment due to discrepancies between the traffic forecast and the evaluated alternatives. The inclusion of future planned projects led to discrepancies in the number of general purpose lanes and interchanges on I-40. Additionally, there were discrepancies in the build alternatives regarding the location of the direct access connections and open access areas for the managed lanes. A summary of the I-40 mainline AADT volumes for each of the three alternatives is shown in **Table 5**.

Table 5: 2040 I-40 Mainline AADT Volume by Alternative (use “softer colors”

Segment	No-Build¹	One Managed Lane^{1,2}	Two Managed Lanes^{1,2}
I-85 to Old NC 86	83,400	82,900	84,800
Old NC 86 to New Hope Church Rd	95,600	96,300	98,400
New Hope Church Rd to NC 86	100,100	101,800	104,200
NC 86 to US 15-501	111,900	114,900	117,900
US 15-501 to NC 54	131,800	142,300	146,600
NC 54 to NC 751	175,500	189,400	195,100
NC 751 to Fayetteville Rd	170,300	183,000	188,200
Fayetteville Rd to NC 55	187,600	197,100	201,800
NC 55 to Alston Avenue	189,200	208,900	215,700
Alston Avenue to NC 147	189,200	208,900	215,700
NC 147 to Davis Dr	223,500	247,100	254,400
Davis Dr to S. Miami Blvd	229,200	251,700	258,900
S. Miami Blvd to Page Rd	249,500	272,000	278,900
Page Rd to I-540	260,000	283,200	290,000
I-540 to Airport Blvd	217,700	233,200	238,400
Airport Blvd to Aviation Pkwy	209,200	223,900	229,600
Aviation Pkwy to N. Harrison Ave	238,300	253,200	259,100
N. Harrison Ave to Wade Ave	245,500	263,700	269,500

Green – Below Capacity, Yellow – Approaching Capacity, Orange – At Capacity, Red – Over Capacity

1. Capacity determination represents worst case of the AM and PM peak hour v/c analysis.
2. For the Build Alternatives, capacity determination represents operations of the general purpose lanes.

The managed lanes will operate below capacity.

Note: AADT volumes do not match traffic forecast due to differences between the forecast and design described in the Traffic Operations Technical Memorandum. AADT volumes were determined by taking

the sum of the eastbound and westbound balanced and rerouted peak hour volume on the I-40 mainline, and dividing by the design hourly volume percentage from the traffic forecast.

As discussed, at the feasibility study stage, uncertainty exists with the design elements, including the interchange forms and managed lanes access types and locations. A volume to capacity (v/c) ratio analysis was determined to be an appropriate level of analysis and measure of effectiveness to provide an order of magnitude comparison between alternatives. Due to the length of the corridor and level of congestion, the v/c ratio methodology allows for an efficient way to evaluate and compare the alternatives. It should be noted that the methodology examines the operations of the individual segment to identify capacity issues but does not take into account what is occurring upstream or downstream of the location. An over capacity freeway segment would potentially cause queuing that impacts the operations of upstream segments and meters traffic volumes to downstream segments. If the project were to move forward into the National Environmental Policy Act (NEPA) process, more detailed traffic analysis and updated traffic forecasts would be required.

The managed lanes provide the I-40 Build Alternatives with additional capacity that, by design, would operate under capacity. In the peak hour of the design year 2040 of the No-Build, One Managed Lane and Two Managed Lanes Alternatives, most of the general purpose lane segments west of US 15-501 would have a v/c ratio below or approaching capacity while most of the segments east of US 15-501 would be at or above capacity. The Two Managed Lanes Alternative would have improved operations compared to the One Managed Lane Alternative, which would have slightly better operations than the No-Build Alternative. A summary of the general purpose lane operations is shown in **Table 6**.

Table 6: 2040 Summary of I-40 General Purpose Lanes Analysis Results

V/C Ratio Range	Length (in miles) of I-40 Corridor within V/C Ratio Range					
	AM Peak Hour			PM Peak Hour		
	No-Build	Build 1 ML	Build 2 ML	No-Build	Build 1 ML	Build 2 ML
0.00 - 0.75 (Below Capacity)	18.4	22.0	24.3	18.6	23.5	24.5
0.75 - 0.90 (Approaching Capacity)	9.1	6.9	6.1	8.6	5.6	5.1
0.90 - 1.00 (At Capacity)	7.4	6.1	5.0	6.6	5.0	4.9
>1.00 (Over Capacity)	26.9	26.9	26.4	28.1	27.7	27.4

Corridor V/C Ratio	1.01	0.97	0.96	1.00	0.96	0.95
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Green – Below Capacity, Yellow – Approaching Capacity, Orange – At Capacity, Red – Over Capacity

9 Cost Estimates

Table 7 shows the construction, ITS, utility relocation, and right of way cost estimates for Alternatives 1 and 2.

Table 7: Cost Estimates

	Alternative 1 One Managed Lane			Alternative 2 Two Managed Lanes		
	West	Central	East	West	Central	East
Construction Cost	\$214,000,000	\$359,000,000	\$410,000,000	\$235,000,000	\$382,000,000	\$413,000,000
ITS	\$1,700,000	\$1,400,000	\$600,000	\$1,700,000	\$1,400,000	\$600,000
Utility Relocation*	\$2,500,000	\$3,700,000	\$2,500,000	\$2,500,000	\$3,700,000	\$2,500,000
R/W Cost*	\$11,700,000	\$31,800,000	\$7,700,000	\$11,700,000	\$31,800,000	\$7,700,000
Total Cost	\$229,900,000	\$395,900,000	\$420,800,000	\$250,900,000	\$418,900,000	\$423,800,000

*Utility cost and R/W cost are provided for the ultimate condition of two managed lanes each direction.

West-From I-85 in Orange County to 1.5 miles west of NC 54 in Durham County

Central-From 1.5 miles west of NC 54 to 0.4 miles (2000') east of South Miami Boulevard in Durham County

East-From 0.4 miles (2000') east of South Miami Boulevard in Durham County to 0.7 miles (3500') east of North Harrison Avenue in Wake County

10 Impacts

As part of this feasibility study, various potential impacts to the human and natural environment were assessed in order to aid the NCDOT in project planning and development. Impacts were assessed using the following resources:

- internet research
- Geographic Information Systems (GIS) layers received from NCDOT
- aerial photography (NC OneMap dated 2010)
- file research (for historic architectural resources, threatened and endangered species, and important natural areas)

- USGS topographic maps
- GIS Data for Orange, Durham, and Wake Counties

It should be noted that extensive environmental studies were not done as part of this feasibility study and would need to be completed in future stages of planning for this project.

Table 8 summarizes the potential impacts to the human and natural environment for Alternatives 1 and 2. The impacts for Alternative 1 and Alternative 2 are the same since they are both within the same area defined by the construction limits. More detailed information about impact analysis for each is provided after **Table 8**.

Table 8: Impact Summary

Issue	<u>Alternative 1 and Alternative 2</u> 1 Managed Lane or 2 Managed Lanes Each Direction
Community Services and Facilities	1
Residential Relocations	0
Businesses Relocations	0
Churches	0
Environmental Justice¹	minimal
Historic and Archaeological Resources	minimal
Walter Curtis Hudson Farm and Store	0.001 acre
Section 4(f)/6(f) Resources	
William B Umstead State Park	3.15 acres
Leigh Farm Park	0.10 acres
Stream, Wetlands, and Floodplain	
Stream impacts (linear feet)	51,200
Wetlands (acres)	54
Floodplains (acres)	86
Federally Protected Species²	Pending species surveys
Hazardous Materials Potential	3 parcels
Land Use Impacts (Acres)	
Residential	14.96
Commercial	38.71

Issue	<u>Alternative 1 and Alternative 2</u> 1 Managed Lane or 2 Managed Lanes Each Direction
Industrial	17.03
Utility	0.001
Churches	1.29
School	1.00
Vacant or Forested	25.99
Community Facility	2.10
Cemetery	0.10
Government	21.09
<i>Total Land Impacted</i>	123.22
Air Quality Impact³	minimal
Traffic Noise (change in noise when compared to No-Build Alternative)⁴	minimal

1. Environmental Justice Neighborhoods are in the project study area, impacts are expected to be minimal.
2. Section 10.6 provides a list of federally protected species; detailed surveys will be required to confirm these species absence or presence in the project study area.
3. Air Quality assessment will be required to further evaluate potential impacts.
4. A Noise Impact assessment will be required to further evaluate potential noise impacts.

10.1 Social Impacts

Social impacts for the proposed projects are expected to be minimal with no adverse effects within the study area. Those in the community most likely to be affected by Alternatives 1 and 2 are those located adjacent to the project corridor. Land from the properties fronting I-40 within the project limits would be required for right-of-way. Impacts resulting from noise on nearby neighborhoods will be further evaluated during more detailed analysis of the Project. Traffic modeling indicates that the proposed Project will improve travel times throughout the corridor, which will allow study area residents and businesses to reach their destinations more quickly and efficiently. This will reduce travel costs for businesses and allow residents to save time and access social services and businesses more easily.

10.1.1 Community Facilities

Community facilities include schools, churches, fire stations, parks and recreation centers, libraries, hospitals, schools and post offices. There are four parks adjacent to the project study area, Crabtree Park, William B. Umstead Park, Leigh Farm Park, and Jordan Lake State Park. Alternatives will be reviewed to minimize impacts to these park and recreation areas. Cedar Forest High School is located in Orange County at the location of the I-85 and I-40 interchange and is directly adjacent to the project study corridor.



Lowe's Grove Middle school is located in Durham County south of the I-40 project study area. Two church properties are located along the project corridor, Chapel Hill Wesleyan Church is located in Orange County north of I-40 and Hanmaun Church is located south of I-40 in Durham County. Strayer University and Technology Partnership of Nagoya University Inc. are located within the project study area. Alternatives will be evaluated to avoid impacts to these community facilities.

10.1.2 Community Cohesion

There are businesses, commercial areas, office parks, motels, the Raleigh Durham Airport, Wake Stone Quarry, Town of Cary Wastewater Treatment Facility and residences along the I-40 project study corridor. Residential communities located along I-40 include Popes Crossing, Five Oaks Lakeside Community and Club Facility, East Chapel Hill Neighborhoods, and Darby Glen Townhomes. Southpoint Mall is located on the south side of I-40 in Durham. The U.S. Citizens Immigration Service office is located along the project corridor in Durham County.

Community cohesion impacts include the effects on neighborhoods, mobility and access, travel patterns, and visual impacts. The proposed alternatives have impacts to residential, industrial, and commercial facilities properties located within the proposed construction limits. Impacts to residences and business properties will be minimal with no relocations anticipated as a result of the project.

10.1.3 Relocations

Additional land from several properties, mainly those properties fronting I-40, would be required for additional right-of-way. The proposed right-of-way for Alternative 1 and Alternative 2 would not require the relocation of residential units, commercial facilities, or industrial facilities.

10.1.4 Environmental Justice

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations) was established in 1994 and directs all federal agencies to determine whether a proposed action would have an adverse or disproportionate impact on low-income and/or minority populations. Based on the American Community Survey (ACS) data six block groups in the DSA have low-income populations that exceed NCDOT's Environmental Justice threshold (5 percentage points higher than the county average). Environmental Justice will need to be considered as a result of the minority and low income populations residing in the study area.

10.1.5 Limited English Proficiency

Data was used from the ACS 5-Year Estimates (2008-2012) to identify adults aged 18 or older who speak English less than "Very Well" by language group. The DSA includes 2,076 Spanish-speaking and 1,208 Asian-Pacific language speaking adults that speak English less than "Very Well," which meets the US Department of Justice's Safe Harbor threshold requirement for presence of a LEP population as identified in USDOT's Policy Guidance Concerning Recipients' Responsibilities to Limited English Proficient Persons (2005). This guidance defines the threshold as either five percent of the total Demographic Study Area adult population or 1,000 adult persons within a particular language group who speak English less than "Very Well." In accordance with the Safe Harbor provisions, written translations of vital documents must be provided for the LEP language group in addition to other measures assuring meaningful access. These other measures include use of interpreters when deemed warranted to assist with public participation. These measures comply with Executive Orders 13166 and 12898.

10.1.6 Population and Race

The I-40 project is located in Durham, Orange and Wake counties. **Table 9** summarizes population change from 2000 to 2010 for each county and the state. The overall growth rate for Durham County (19.8 percent) is comparable to the overall growth rate of the state (18.5 percent). The overall growth rate for Wake County (43.5 percent) is more than double the state rate and the growth rate for Orange County (13.2 percent) is less than the state.

The Demographic Study Area is comprised of 30 Census Block Groups on or adjacent to the I-40 project corridor in Durham County (14 block groups), Orange County (10 block groups) and Wake County (6 block groups).

Table 9: Population Trends 2000-2010

Census Geography	2000	2010	Difference	Percent Change 2000 to 2010	
				Overall	Annualized
Durham County	223,314	267,587	44,273	19.8%	1.8%
Orange County	118,227	133,801	15,574	13.2%	1.2%
Wake County	627,846	900,993	273,147	43.5%	3.7%
North Carolina	8,049,313	9,535,483	1,486,170	18.5%	1.7%

Source: US Census Bureau, Census 2010, Tables P001 (2000), P1 (2010) "Total Population"

A review of 2010 Census data for the project study area was conducted to determine whether minority or low-income populations would receive adverse or disproportionate human health or environmental impacts as a result of this project. Census data indicates the presence of minority and low-income populations meeting the criteria for Environmental Justice within the Demographic Study Area. Based on Census data, seven block groups exceed NCDOT's Environmental Justice threshold (10 percentage points higher than the county average) for minority population. These include two block groups with African American populations, five block groups with Asian populations, and three block groups with a Hispanic population some block groups have more than one minority population.

10.2 Historic and Archaeological Resources

Research was conducted online at the North Carolina State Historic Preservation Office database November 22, 2013 to determine if any historic or archaeological resources are eligible for listing on the National Register of Historic Places are located within the project study area. Alternative 1 and Alternative 2 impact areas are directly adjacent to the Walter Curtis Farm and store property. Potential impacts to this historical resource are very minor and most likely avoidable.

10.3 Section 4(f) and 6(f) Resources

10.3.1 Background Information

In accordance with Section 4(f) of the Department of Transportation Act of 1966 (49 USC § 303) and 23 CFR § 771.135, the FHWA "may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless a determination is made that: (i) there is no feasible and prudent alternative to the use of land from the property; and (ii) the action includes all possible planning to minimize harm to the property resulting from such use."

Section 6(f) of the Land and Water Conservation Act requires that any recreation lands that have received Land and Water Conservation Fund (LWCF) money and are converted to non-recreational purposes must be replaced with land of equal or greater value, location, and usefulness. Any land conversions on property that has received LWCF money must be approved by the US Department of the Interior – National Park Service (FHWA, 1987: pg. 44).

10.3.2 Section 4(f) and Section 6(f) Impacts

Aerial photography and GIS layers were reviewed for parks, recreation areas, and wildlife and waterfowl refuges to determine potential impacts to 4(f) resources. Jordan Lake State Park and Leigh Farm Park home of the Piedmont Wildlife Center are adjacent to the project study area. Avoidance and minimization to the park land will be evaluated during the design phase of the project.

Research was conducted to determine 6(f) resources within the project study area. The William B. Umstead State Park and Lake Jordan State Park are adjacent to the project study area. Alternatives will be considered for project planning to avoid or minimize impacts to the state park land.

10.4 Hydrology and Drainage

10.4.1 Streams

According to the USGS topographic map for the project area there are a number of streams within the project limits that will be impacted. Stirrup Iron Creek, Third Fork Creek, New Hope Creek, Lake Crabtree/Lake Crabtree Creek, Reedy Creek, Burdens Creek, Northeast Creek, Crooked Creek, Mountain Creek, and Cates Creek are among the major watersheds that pass through the project study area. Existing structures in place along I-40 will require extensions and/or upgrades based on the location of the selected alternative. New interchange construction has the potential to impact additional streams. Stream impacts total to approximately 42,100 lf with additional impacts noted for the Renaissance Parkway concept Alternative of approximately 9,100 lf.

10.4.2 Floodplains

The most recent flood insurance rate map (FIRM) for the project area (dated March 2009) was reviewed on the Federal Emergency Management Agency (FEMA) website (<http://map1.msc.fema.gov>, accessed November 15, 2013). There are floodplains (AE and X) within the project area associated with Cates Creek, New Hope Creek, Third Fork Creek, Stirrup Iron Creek, and Lake Crabtree. Floodplains totals for Alternatives 1 and 2 are 61 acres, with

additional impacts of 25 acres for the Renaissance Parkway concept Alternative for a total of approximately 86 acres.

10.5 Wetlands

A review of the USFWS database was conducted on November 22, 2013 to identify wetlands within the project corridor:

Three major jurisdictional wetlands associated with New Hope Creek, Lake Crabtree, Stirrup Creek and Northeast Creek were identified within the study area. Wetland classification and quality rating data identified the wetland areas as Freshwater Forested Wetlands. The wetlands are located within the Cape Fear and Neuse River Basins (USGS Hydrologic Unit 03030004 and 03020201). Alternative 1 and Alternative 2 would impact approximately 35 acres of wetlands; the Renaissance Parkway concept Alternative will impact an additional 19 acres of wetlands for a total of approximately 54 acres.

Jurisdictional confirmation should be conducted by the U.S. Army Corp of Engineers to determine the exact location of wetlands within the project for future planning stages for this project. Wetland impacts could change based on the results of jurisdictional determination for this project.

10.6 Federally Protected Species

Plants and animals with federal classifications of Endangered (E), Threatened (T), Proposed Endangered (PE), and Proposed Threatened (PT) are protected under provisions of Section 7 and Section 9 of the Endangered Species Act (ESA) of 1973, as amended.

There are eight federally protected species listed for Orange, Durham, and Wake Counties by the US Fish and Wildlife Service (USFWS) (<http://www.fws.gov>, accessed April 16, 2015). They are listed below:

- Bald eagle (*Haliaeetus leucocephalus*) – Bald and Golden Eagle Protection Act
- Red-Cockaded woodpecker (*Picoides borealis*) – Endangered
- Dwarf wedgemussel (*Alasmidonta heterodon*) – Endangered
- Cape Fear shiner (*Notropis mekistocholas*) – Endangered
- Tar River spiny mussel (*Elliptio steinstansana*) – Endangered
- Michaux's Sumac (*Rhus michauxii*) – Endangered

- Smooth Coneflower (*Echinacea laevigata*)-Endangered
- Northern long-eared bat (*Myotis septentrionalis*)-Threatened

According to the North Carolina Natural Heritage Program, habitat for the bald eagle consists of mature forests near large bodies of water. The USGS topographic map for the project study area contains a number of large tributaries and open water areas. Stirrup Iron Creek, Third Fork Creek, and Lake Crabtree are located within the project study area and contain mature forest with creeks and large bodies of open water having potential habitat for the bald eagle.

According to the USFWS website (www.fws.gov), accessed April 16, 2015 habitat for the Red-Cockaded woodpecker consists of mature pine forests—specifically those with longleaf pines averaging 80 to 120 years old and loblolly pines averaging 70 to 100 years old. Longleaf pine is a characteristic tree of the Coastal Plain, particularly the Sandhills region also occurring in a few locations in the Piedmont. Loblolly pine forest occurs in the Coastal Plain and Piedmont Region. There is mature forest present within the study corridor that could have both longleaf and/or loblolly pine creating potential habitat occurrence within the study area for the Red-Cockaded woodpecker. Detailed surveys for Red-Cockaded woodpecker should be performed to ensure there are no occurrences of this species in the project study area

According to the USFWS website (www.fws.gov), accessed April 16, 2015, habitat for the Dwarf Wedge Mussel consist of a variety of substrates including gravel, coarse sands, fine sands and clays in creeks and rivers of various sizes. North Carolina supports the greatest number of known sites to include the Neuse River Basin in Orange County and Wake County. Impacts including riparian disturbance, pollution, sedimentation, impoundments, artificial flow regimes, and stream fragmentation disrupt mussel life cycles, and prohibit recolonization; resulting in reduced recruitment rates and decreased population. The project study area is comprised of various tributaries that could support favorable habitat for Dwarf Wedge Mussel. Orange and Wake Counties have been identified as having known populations of Dwarf Wedge Mussel. Detailed surveys for Dwarf Wedge Mussel should be performed to ensure there are no occurrences of this species in the project study area.

According to the USFWS website (www.fws.gov), accessed April 16, 2015, habitat for the Tar River spiny mussel consist of relatively silt-free uncompacted gravel and/or coarse sand in fast-flowing, well oxygenated stream reaches. It is found in association with other mussels. The Tar River spiny mussel is endemic only to the Tar River and Neuse River systems in North Carolina. In the Neuse River system, the species has been documented only from the Little River. Based on available data, all surviving populations of the Tar River spiny mussel are small in size, highly fragmented and isolated from one another, and in decline. The primary factors affecting the

species and its habitat are stream impacts (sedimentation, bank instability, loss of instream habitat) associated with the loss of forest lands and forested riparian buffers, and stormwater runoff of silt and other pollutants. The project study area is comprised of various tributaries that could support favorable habitat for the Tar River spiny mussel. Coordination with the USFWS and North Carolina Ecological Services should be completed to determine necessity of a species survey in any location of concern within the project study area.

According to the USFWS website (www.fws.gov), accessed April 16, 2015, habitat for the Cape Fear shiner is associated with gravel, cobble, and boulder substrates, and has been observed in slow pools, riffles, and slow runs. The Cape Fear shiner is endemic to the upper Cape Fear River Basin in the Central Piedmont of North Carolina. The species is known from tributaries and mainstems of the Deep, Haw and Rocky Rivers in Chatham, Harnett, Lee, Moore and Randolph counties. Only five populations of the shiner are thought to exist. There are no known populations in the project study corridor, coordination with the USFWS and North Carolina Ecological Services should be completed to determine necessity of a species survey in any location of concern within the project study area.

According to the USFWS website (www.fws.gov), accessed April 16, 2015, Michaux's sumac grows in sandy or rocky open woods in association with basic soils. The plant is also known to survive best in areas where some form of disturbance has provided an open area. Several populations in North Carolina are on highway rights-of way, roadsides, or on the edges of artificially maintained clearings. The project study area is comprised of roadways and open areas creating favorable habitat for Michaux's Sumac. Orange, Durham, and Wake Counties have been identified as having known populations of Michaux's Sumac. Detailed surveys for Michaux's sumac should be performed to ensure there are no occurrences of this species in the project study area.

According to the USFWS website (www.fws.gov), accessed April 16, 2015, Smooth coneflower is typically found in open woods, glades, cedar barrens, roadsides, clear cuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium and calcium rich soils. Optimal sites are characterized by abundant sunlight and little competition in the herbaceous layer. Natural fires, as well as large herbivores, historically influenced the vegetation in this species' range. Many of the herbs associated with Smooth coneflower are also sun-loving species that depend on periodic disturbances to reduce the shade and competition of woody plants. The project study area is comprised of roadways and open areas creating favorable habitat for Smooth coneflower. Orange and Durham Counties has been identified as having known populations of Smooth coneflower. Detailed surveys for smooth coneflower to verify there are no occurrences of Smooth coneflower in the project study area.

According to the USFWS website (www.fws.gov), accessed April 16, 2015, Northern long-eared bat is typically found roosting singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. Specific areas where they hibernate have very high humidity. The project study area is comprised of habitat that could support the Northern long-eared bat. Coordination with the USFWS and North Carolina Ecological Services should be completed to determine necessity of a species survey in any location of concern within the project study area.

Surveys for federally protected species should be updated and conducted by qualified biologists during future planning phases of this project.

10.7 Hazardous Materials

Hazardous material is defined as any material, or combination of materials that pose a hazard to human health, welfare, or the environment. Hazardous material sites may include underground storage tanks, auto salvage yards, landfills, and lagoons. Hazardous materials take the form of gas, liquid, sludge, or solids, and can be radioactive, corrosive, flammable, explosive, infectious, toxic, or reactive.

A review of geographic information data was conducted within the proposed study area, any sites adjacent I-40 project limits that appeared likely to contain hazardous materials were considered. There are three sites within the project corridor that have potential hazardous materials; it is not likely that storage facilities or structures containing hazardous materials will be impacted. This was not a comprehensive investigation. A hazardous materials field investigation should be conducted in future planning phases of this project to locate any potential hazardous materials sites within the project study area.

10.8 Utilities

Major existing utilities within the project study area include overhead telephone lines, electrical transmission lines, gas lines, water lines, and sanitary sewer lines.

In Orange County Incorporated areas are served by Duke Energy and unincorporated areas are served by Piedmont Electric Membership Corporation. Orange Water and Sewer Authority provides water and sewer services. Public Service of North Carolina (PSNC) provides natural gas services to all local areas in Orange County. Telephone service is provided by Century Link

and BellSouth Telecommunications, LLC an operating company of AT&T that serves the southeastern United States.

Duke Energy and the Wake Electric Membership Corporation provide electricity in Wake County. AT&T, Century Link, Time Warner Cable and Verizon are the primary providers of advanced telecommunications service to residents and businesses in Wake County. PSNC is the gas provider. The two largest providers of water and sewer service in Wake County are the City of Raleigh and Western Wake Partners.

In Durham County electricity is provided by Duke Energy and Piedmont Electric Membership Corporation. Bell South and Frontier Communications are providers for phone service. PSNC is the supplier of gas and Time Warner provides cable services. City of Durham Water Management provides water and sewer services.

All utility providers should be contacted and coordinated with to ensure that the proposed design and construction of the project would not disrupt service.

10.9 Air Quality

Air quality is regulated under the federal Clean Air Act (CAA) of 1970 and 1990, as amended (42 USC Sections 7401-7671q). The CAA was enacted for the purposes of protecting and enhancing the quality of the nation's air resources to benefit public health, welfare and productivity. The Environmental Protection Agency (EPA) is the federal regulatory agency charged with administering the CAA. The CAA established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation and buildings.

The EPA classifies urban environments as being either in "attainment" or "non-attainment." An urban area that exceeds the National Ambient Air Quality Standards (NAAQS) for one or more pollutants is said to be in "non-attainment" of the NAAQS enforced under the CAA. The EPA established primary and secondary NAAQS for six air pollutants: carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone (O₃), particulate matter (PM) and lead (Pb). The designation of an area is determined on a pollutant-by-pollutant basis.

Attainment areas can be further categorized as a maintenance area for attainment, which means that the urban area has exceeded NAAQS levels for one or more pollutants in the past. Efforts in these maintenance areas must be made in order to maintain the status quo and not exceed the

NAAQS. Non-attainment areas are classified in severity by pollutant depending on the degree of exceedance(s) over the NAAQS.

Durham and Wake Counties are in an Air Quality (AQ) maintenance area for the Carbon Monoxide standard. Durham, Orange, and Wake Counties are within an 8-hour Ozone maintenance area. Projects in this area are modeled as described in the Long Range Transportation Plan (LRTP) and the Transportation Improvement Program (TIP) to demonstrate conformity and any changes to the project description (# of lanes/project length) or if the project is accelerated/delayed (project completion crosses horizon years) it can impact the transportation conformity determination and Federal approvals/ actions on the project.

<https://connect.ncdot.gov/projects/planning/Pages/AirQualityTransportationConformity.aspx>

The addition of one or two managed lanes along the I-40 corridor are not anticipated to create any adverse effects on the air quality for Durham, Orange, and Wake Counties maintenance areas, thereby complying with the National Ambient Air Quality Standards.

10.10 Noise

The NCDOT *Traffic Noise Abatement Policy* effective July 13, 2011 establishes official policy on highway noise. This policy describes the NCDOT process that is used in determining traffic noise impacts and abatement measures and the equitable and cost-effective expenditure of public funds for traffic noise abatement. Where the FHWA has given highway agencies flexibility in implementing the 23 CFR 772 standards, this policy describes the NCDOT approach to implementation.

Noise impacts are anticipated in the project study area as a result of construction and increase vehicle traffic. Noise barriers for Alternative 1 and Alternative 2 are recommended to meet feasibility and reasonableness requirements based on available information. The final decision on feasibility and reasonableness of the noise barriers will be made upon completion of the project design and the public involvement process. Changes may occur as more detailed information on mapping and final design becomes available.

NCDOT *Traffic Noise Abatement Policy* (July 2011), the following traffic noise abatement measures may be considered: highway alignment selection, traffic systems management, buffer zones, noise barriers (earth berms and noise walls), and noise insulation of Activity Category D land use facilities. Noise abatement measures must be approved by the FHWA prior to implementation.

11 Recommendation

Based on the data and analysis conducted for this feasibility study, Alternative 2 (two managed lanes in each direction) is the preferred alternative because it would best meet the long term needs of the corridor by providing a more reliable travel time thru the corridor because of the flexibility of having 2 managed lanes per direction at only a modest increase in costs. Given the existing conditions on this section of I-40, major reconstruction of much of the infrastructure is needed to accommodate either the one or two lane managed lanes per direction and our estimates indicate that the costs of constructing Alternative 2 (two managed lanes per direction) is only 4.4 percent more than Alternative 1 providing one managed lane per direction. Direct access would be incorporated at interchange improvements within the project area. Current access locations are preliminary and a final determination would come during later planning and design phases.

However, a final determination on the number of managed lanes will not be made until later planning and design phases. Some sections may be able to function with only one managed lane per direction. Therefore, the cost of managed lanes on I-40 from I-85 to Wade Avenue is expected to range from \$1,046,600,000 to \$1,093,600,000 depending on the ultimate configuration and direct access accommodations.

The road improvements would be designed to accommodate alternate commuter options to include managed lanes, BRT, and LTR. The improvements would be phased to incorporate the HOT/HOV lanes to meet long range transportation plans for I-40 and would improve traffic flow.

12 Other Alternatives Considered

Two alternatives at the Reedy Creek Road Interchange were further evaluated. One alternative consisted of a general purpose diamond interchange that would relocate existing Old Reedy Creek Road to the west. The second alternative did not include a new general purpose interchange, but provided an additional weave access ramp to the express lanes. The two alternatives are discussed in further detail below.

NCDOT was requested by local stakeholders to investigate the addition of a general purpose interchange at Old Reedy Creek Road. A design was developed consisting of a simple diamond interchange including four ramps providing full access between Old Reedy Creek Road and I-40. This interchange would require the realignment of Old Reedy Creek Road. A general purpose

interchange at this location would provide an additional connection to I-40 from both the nearby business parks and nearby residential areas helping to alleviate the congestion around the Harrison Avenue interchange located east of Old Reedy Creek Road. The interchange would have several adverse effects including construction of two additional bridges over Crabtree Creek, impacts to Lake Crabtree, impacts to Umstead Park, and impacts to the water treatment plant along the south side of I-40. In addition to the impacts, the topography of the area would increase the overall construction cost as a result of the structure that would be required to construct the interchange.

After reviewing the impacts of the general purpose interchange, NCDOT evaluated another alternative that would alter the interchange to only include access to and from the express lanes. This design includes a two lane raised ramp in the median of I-40 that connect to a realigned Old Reedy Creek Road to form a stop controlled intersection. This interchange design would also require the realignment of Old Reedy Creek Road. A HOT lane connection at this crossing would provide express lane access to the business park and residential area. While this design still includes significant bridge construction the express lane connection largely reduces the impacts to Crabtree Creek, Lake Crabtree and the water treatment plant.

Resources:

National Environmental Policy Act

NCDOT Accident Data

NCDOT Crash Rates, Division 5 and 7: <https://connect.ncdot.gov/resources/safety>

Geographic Information System (GIS) Orange, Durham, and Wake Counties

Aerial Photography Orthoimagery_2010 from NC OneMap

http://services.nconemap.com/arcgis/services/Imagery/Orthoimagery_2010/ImageServer.

Google Earth

North Carolina State Historic Preservation Office database

USFWS: <http://www.fws.gov>

Federal Emergency Management Agency: <http://map1.msc.fema.gov>

Air Quality Transportation Conformity Website:

<https://connect.ncdot.gov/projects/planning/Pages/AirQualityTransportationConformity.aspx>

NCDOT Traffic Noise Abatement Policy (July 2011)

US Census www.census.gov

Our Transit Future <http://ourtransitfuture.com/tag/technology/>

Durham County Utility Providers <http://www.durham-nc.com>

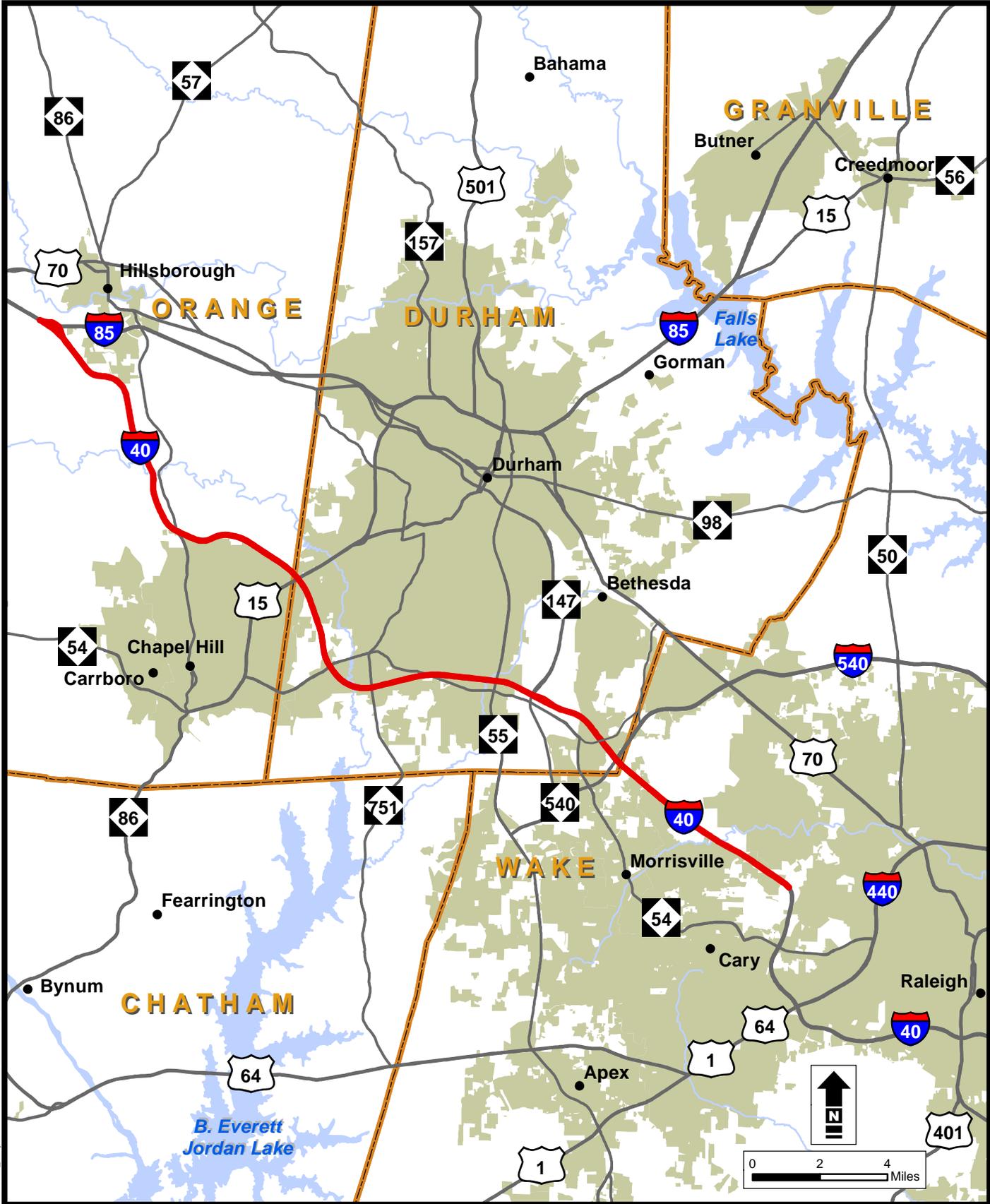
Wake County Utility Providers <http://www.raleigh-wake.org/page/utilities>

Orange County Utility Providers <http://www.co.orange.nc.us/AssetMgmt/utilities.asp>

Atkins. 2015. Traffic Operations Technical Memorandum.

I-40 High Occupancy Vehicle Congestion Management Study. March 2003.

FIGURES



FS1205A_ProjectLocation.ai_JNL 01.06.2015

I-40 FEASIBILITY STUDY



STIP PROJECT
NO. FS-1205A
Orange, Durham,
& Wake Counties

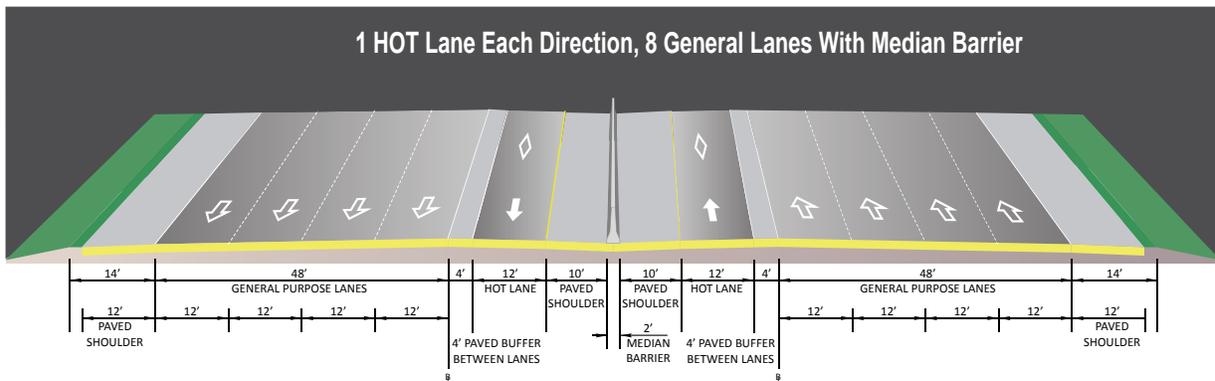
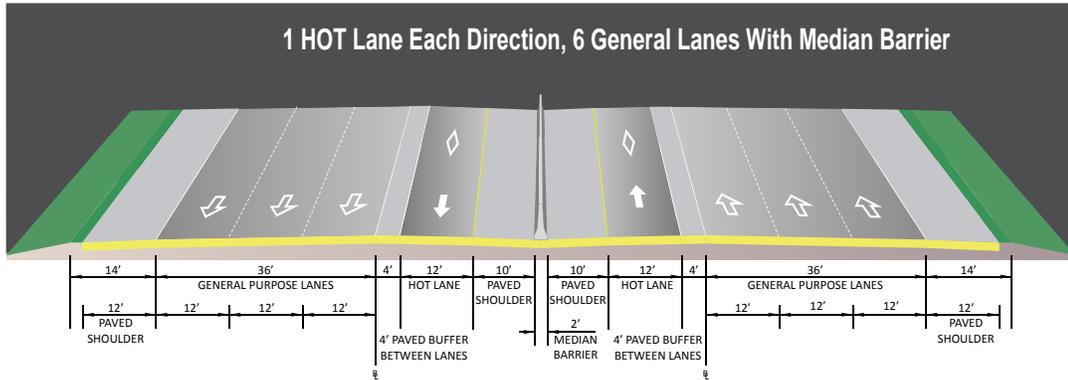
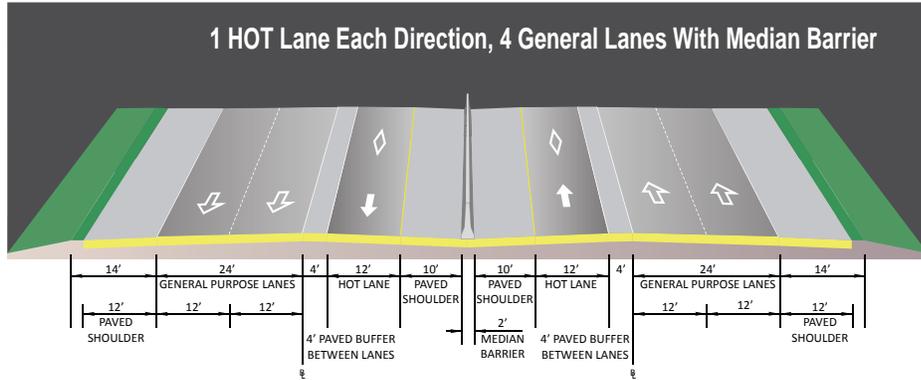
LEGEND

- FS-1205A Project
- County Boundary
- Cities
- Municipalities
- Hydrology

Source: NCDOT, NCOneMap

PROJECT LOCATION

FIGURE 1



I-40FS_TypicalSections.ai - JNL 01.22.2015

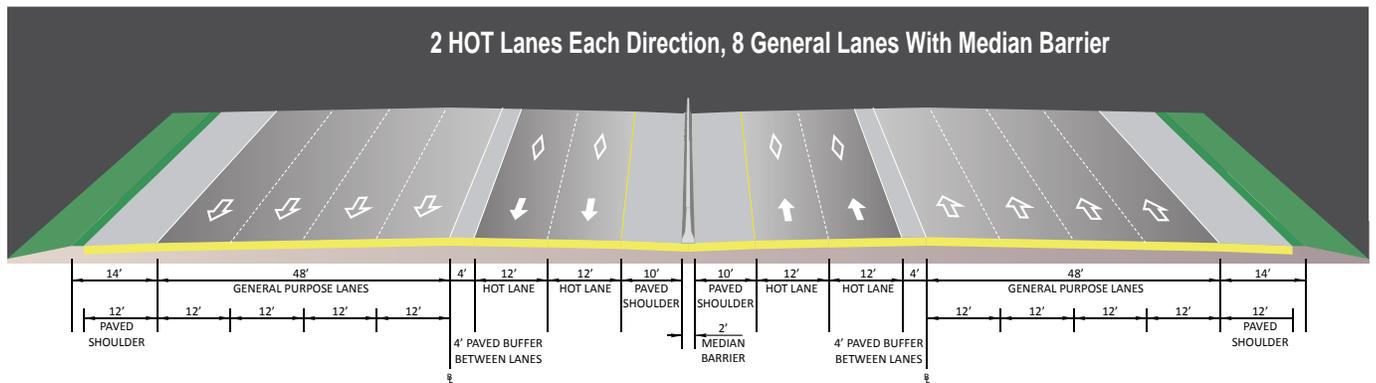
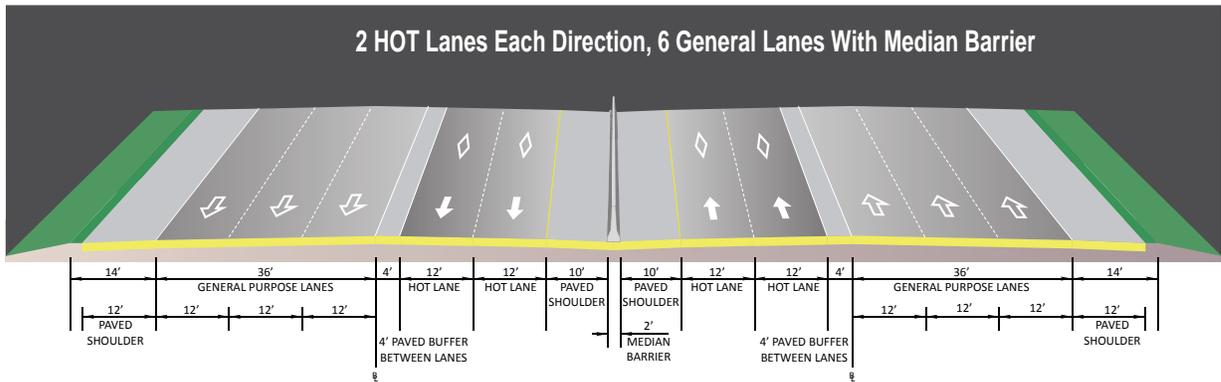
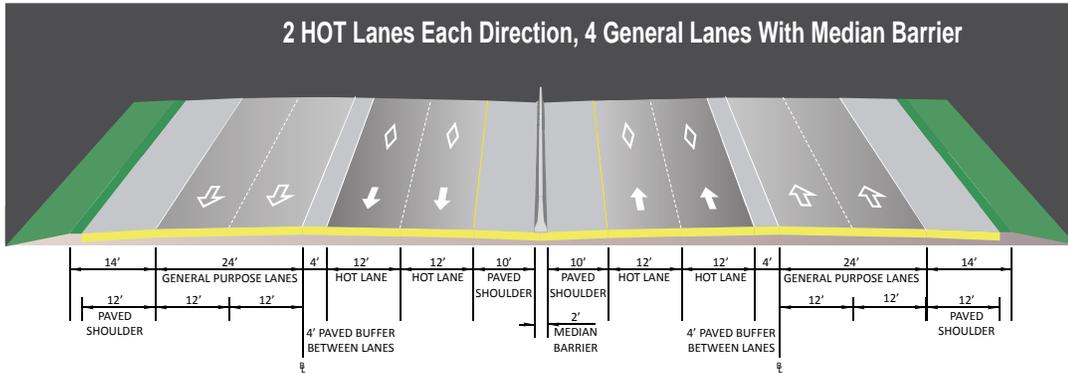
I-40 FEASIBILITY STUDY



STIP PROJECT
NO. FS-1205A
Orange, Durham,
& Wake Counties

TYPICAL SECTIONS

**ALTERNATIVE 1
ONE MANAGED LANE
EACH DIRECTION
FIGURE 2**



I-40FS_TypicalSections.ai - JUN 01 22:20:15

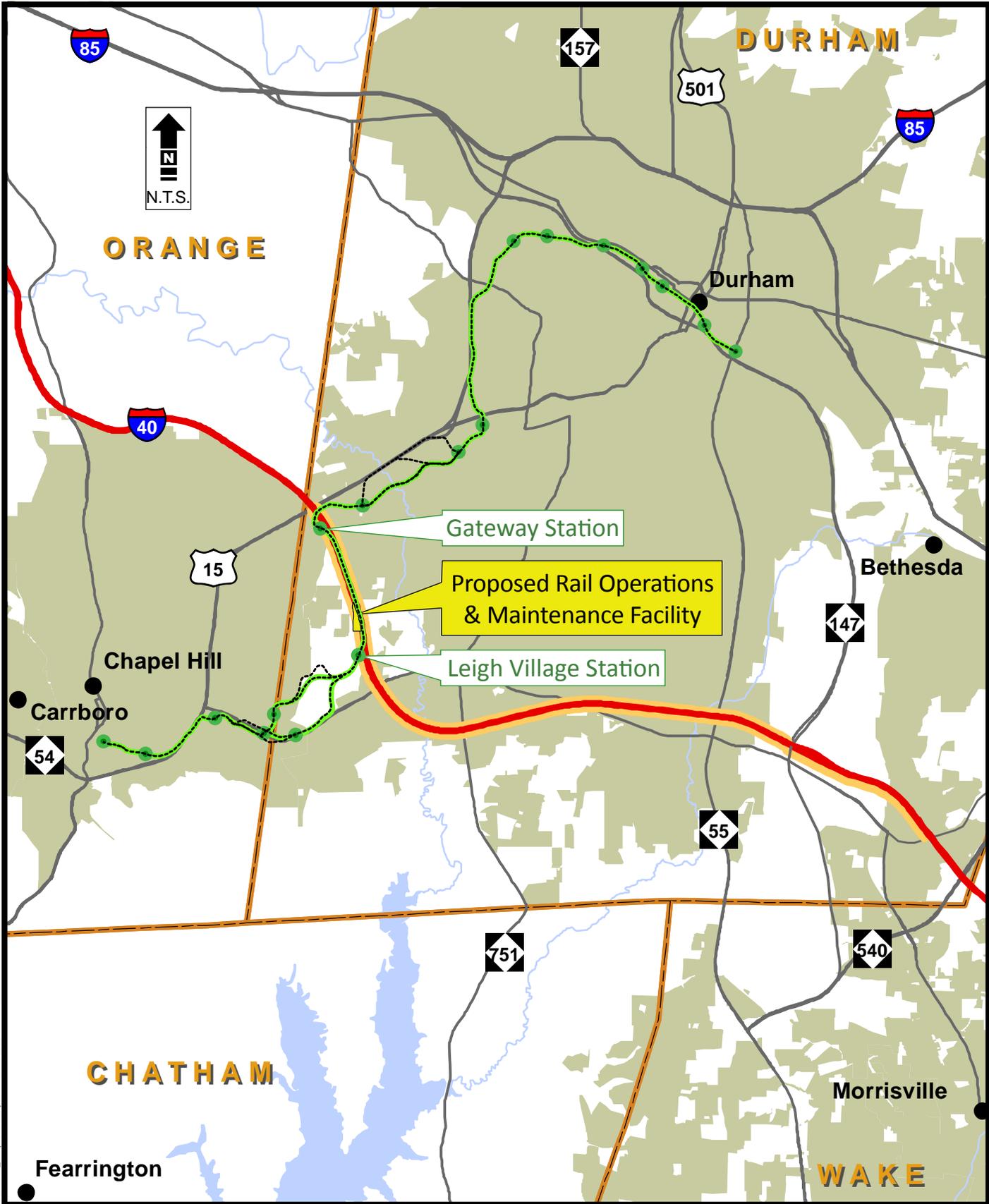
I-40 FEASIBILITY STUDY



STIP PROJECT
NO. FS-1205A
Orange, Durham,
& Wake Counties

TYPICAL SECTIONS

**ALTERNATIVE 2
TWO MANAGED LANES
EACH DIRECTION
FIGURE 2A**



FS1205A_ProposedProjects.ai - JNL - 01.23.2015

I-40 FEASIBILITY STUDY



STIP PROJECT NO. FS-1205A

Orange, Durham, & Wake Counties

LEGEND

- FS-1205A Project
 - - - Durham-Orange LRT LPA *
 - Proposed LRT Stations
 - BOSS**
 - Potential Future Bus Service
 - County Boundary
 - Hydrology
 - Municipalities
- * LRT = Light Rail Transit
 LPA = Locally Preferred Alternative
 ** BOSS = Bus on Shoulder System

FUTURE TRANSIT PROJECTS

FIGURE 3

Source: Triangle Transit (info@ourtransitfuture.com), NCDOT, NCOneMap

APPENDIX A

Proposed Designs

ORANGE COUNTY

BEGIN
FS-1205A

Cedar Ridge
High School

Hillsborough

ORANGE GROVE RD

OLD NC 86 / SR 1009

85

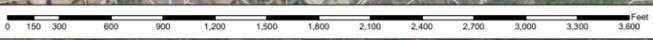
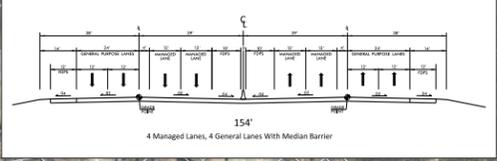
40

I-40 FEASIBILITY STUDY



STIP PROJECT
NO. FS-1205A
Orange, Durham,
& Wake Counties

MAP 1 OF 10



Legend

- Prop Horizontal Alignment
- Prop Edge of Travel
- Prop Lane Lines
- Prop Paved Shoulder
- Prop Conc Barrier
- Prop Conc Curb and Gutter
- Prop Retaining Wall
- - - Prop SS Cut Line
- - - Prop SS Fill Line
- - - Prop SS Transition Line
- ⊕ Proposed Right of Way
- ⊕ Existing Bridges and Culverts
- ⊕ Proposed Bridges and Culverts
- + Railroad
- Pipe and Transmission Lines
- ⊕ Cemeteries
- ⊕ Churches
- ⊕ Hazardous Waste Sites
- ⊕ Schools
- ⊕ Historic Nat'l Register Districts
- ➔ Managed Lane
- ➔ General Purpose Lane
- ▭ County Border
- ▭ State Parks
- ▭ Parcels
- ▭ Land Trust Conservation Properties
- ▭ Dedicated Nature Preserves
- ▭ State-owned Conservation Easements
- Streams
- Bodies of Water

-LEBI-
PI Sta 15+02.40
D = 715.00' (RT)
L = 203.46'
T = 334.49'
R = 7.33200°

PI Sta 14+12.36
D = 14.55' (RT)
L = 1.57' (RT)
T = 4.94' (RT)
R = 3.78800°

-WBI-
PI Sta 15+02.40
D = 715.00' (LT)
L = 203.46'
T = 334.49'
R = 7.33200°

PI Sta 14+12.36
D = 14.55' (LT)
L = 1.57' (LT)
T = 4.94' (LT)
R = 3.78800°

MATCHLINE SHEET
LEB- 56. 145.1.00

86

ORANGE COUNTY

NORFOLK SOUTHERN RR

3000' WEAVE SECTION

3000' WEAVE SECTION

40

NEW HOPE CHURCH RD

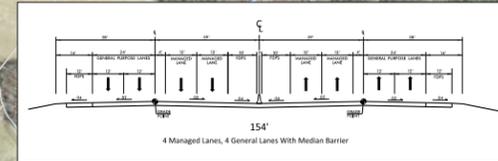
Hillsborough

-WBC-

PI Sta. 108+00.00	PI Sta. 109+75.54	PI Sta. 111+50.00
Δ = 17° 52' 31.4" (RT)	Δ = 17° 52' 31.4" (RT)	Δ = 17° 52' 31.4" (RT)
D = 128.71'	D = 128.71'	D = 128.71'
L = 128.71'	L = 128.71'	L = 128.71'
T = 128.71'	T = 128.71'	T = 128.71'
R = 128.71'	R = 128.71'	R = 128.71'

-LEB-

PI Sta. 141+23.16	PI Sta. 142+107.41	PI Sta. 143+00.00
Δ = 14° 58' 30.4" (RT)	Δ = 14° 58' 30.4" (RT)	Δ = 14° 58' 30.4" (RT)
D = 154.43'	D = 154.43'	D = 154.43'
L = 154.43'	L = 154.43'	L = 154.43'
T = 2,268.53'	T = 1,767.36'	T = 79.75'
R = 3,786.00'	R = 11,540.00'	R = 2,936.00'



I-40 FEASIBILITY STUDY

STIP PROJECT NO. FS-1205A

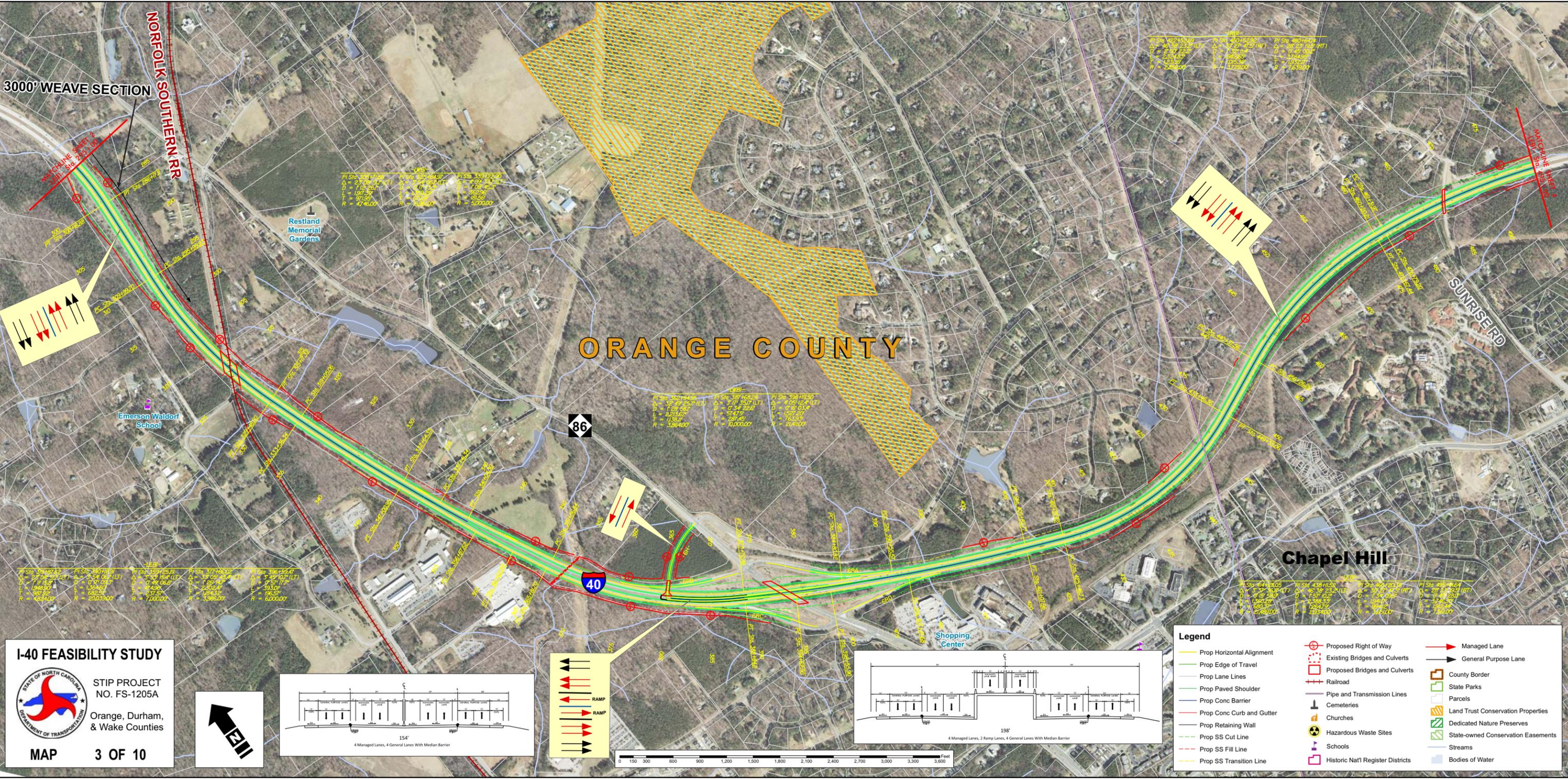
Orange, Durham, & Wake Counties

MAP 2 OF 10



Legend

Prop Horizontal Alignment	Existing Bridges and Culverts	Managed Lane
Prop Edge of Travel	Proposed Bridges and Culverts	General Purpose Lane
Prop Lane Lines	Railroad	County Border
Prop Paved Shoulder	Pipe and Transmission Lines	State Parks
Prop Conc Barrier	Cemeteries	Parcels
Prop Conc Curb and Gutter	Churches	Land Trust Conservation Properties
Prop Retaining Wall	Hazardous Waste Sites	Dedicated Nature Preserves
Prop SS Cut Line	Schools	State-owned Conservation Easements
Prop SS Fill Line	Historic Nat'l Register Districts	Streams
Prop SS Transition Line		Bodies of Water

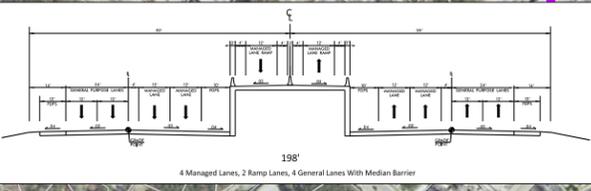
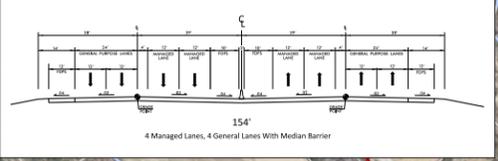


I-40 FEASIBILITY STUDY

STIP PROJECT NO. FS-1205A

Orange, Durham, & Wake Counties

MAP 3 OF 10



Legend

Prop Horizontal Alignment	Proposed Right of Way	Managed Lane
Prop Edge of Travel	Existing Bridges and Culverts	General Purpose Lane
Prop Lane Lines	Proposed Bridges and Culverts	County Border
Prop Paved Shoulder	Railroad	State Parks
Prop Conc Barrier	Pipe and Transmission Lines	Parcels
Prop Conc Curb and Gutter	Cemeteries	Land Trust Conservation Properties
Prop Retaining Wall	Churches	Dedicated Nature Preserves
Prop SS Cut Line	Hazardous Waste Sites	State-owned Conservation Easements
Prop SS Fill Line	Schools	Streams
Prop SS Transition Line	Historic Nat'l Register Districts	Bodies of Water



DURHAM COUNTY

Durham

ORANGE COUNTY

Chapel Hill

East Chapel Hill High School

WEAVER DAIRY RD

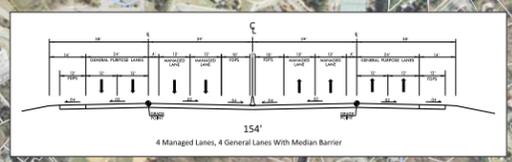
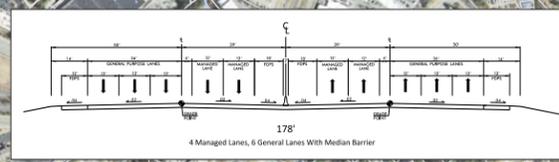
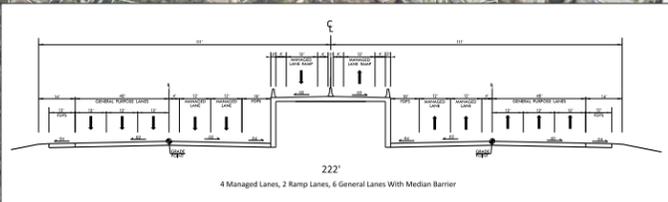
MT MORAH RD

OLD CHAPEL HILL RD

ERWIN RD

SUNRISE RD

3000' WEAVE SECTION



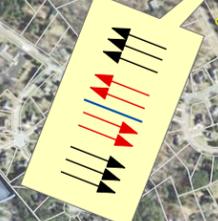
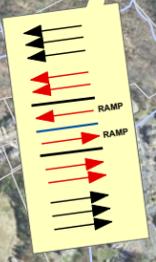
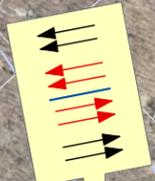
Legend			
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	Prop Edge of Travel		Existing Bridges and Culverts
	Prop Lane Lines		Proposed Bridges and Culverts
	Prop Paved Shoulder		Railroad
	Prop Conc Barrier		Pipe and Transmission Lines
	Prop Conc Curb and Gutter		Cemeteries
	Prop Retaining Wall		Churches
	Prop SS Cut Line		Hazardous Waste Sites
	Prop SS Fill Line		Schools
	Prop SS Transition Line		Historic Nat'l Register Districts
	Managed Lane		County Border
	General Purpose Lane		State Parks
			Parcels
			Land Trust Conservation Properties
			Dedicated Nature Preserves
			State-owned Conservation Easements
			Streams
			Bodies of Water

I-40 FEASIBILITY STUDY

STIP PROJECT NO. FS-1205A

Orange, Durham, & Wake Counties

MAP 4 OF 10

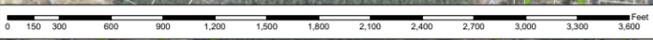
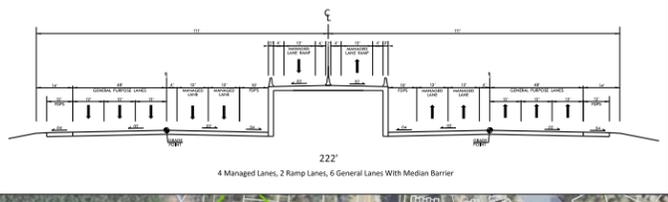
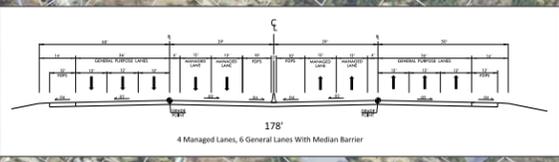


15
501

40



I-40 FEASIBILITY STUDY
 STIP PROJECT NO. FS-1205A
 Orange, Durham, & Wake Counties
 MAP 5 OF 10



Legend			
	Prop Horizontal Alignment		Managed Lane
	Prop Edge of Travel		General Purpose Lane
	Prop Lane Lines		Existing Bridges and Culverts
	Prop Paved Shoulder		Proposed Bridges and Culverts
	Prop Conc Barrier		Railroad
	Prop Conc Curb and Gutter		Pipe and Transmission Lines
	Prop Retaining Wall		Cemeteries
	Prop SS Cut Line		Churches
	Prop SS Fill Line		Hazardous Waste Sites
	Prop SS Transition Line		Schools
			Historic Nat'l Register Districts
			County Border
			State Parks
			Parcels
			Land Trust Conservation Properties
			Dedicated Nature Preserves
			State-owned Conservation Easements
			Streams
			Bodies of Water

DURHAM COUNTY

Durham

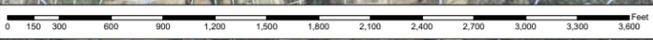
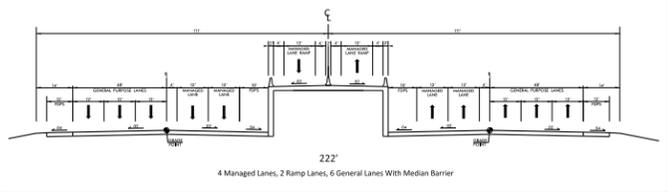
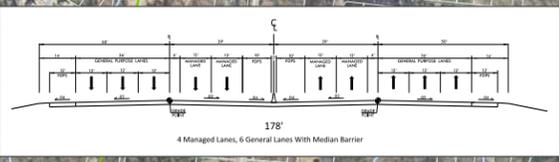
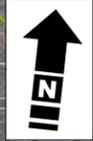


I-40 FEASIBILITY STUDY



STIP PROJECT
NO. FS-1205A
Orange, Durham,
& Wake Counties

MAP 6a OF 10



Legend					
	Prop Horizontal Alignment		Proposed Right of Way		Managed Lane
	Prop Edge of Travel		Existing Bridges and Culverts		General Purpose Lane
	Prop Lane Lines		Proposed Bridges and Culverts		County Border
	Prop Paved Shoulder		Railroad		State Parks
	Prop Conc Barrier		Pipe and Transmission Lines		Parcels
	Prop Conc Curb and Gutter		Cemeteries		Land Trust Conservation Properties
	Prop Retaining Wall		Churches		Dedicated Nature Preserves
	Prop SS Cut Line		Hazardous Waste Sites		State-owned Conservation Easements
	Prop SS Fill Line		Schools		Streams
	Prop SS Transition Line		Historic Nat'l Register Districts		Bodies of Water

DURHAM COUNTY

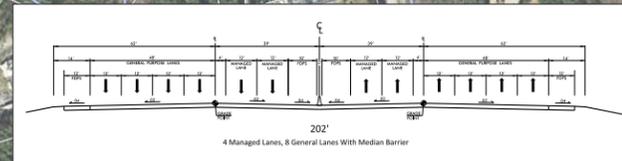
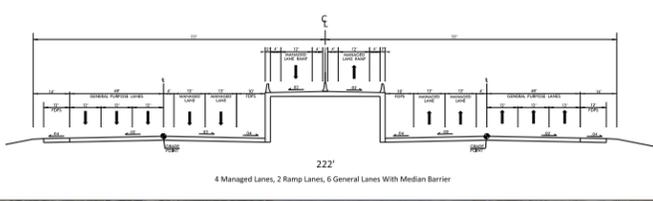
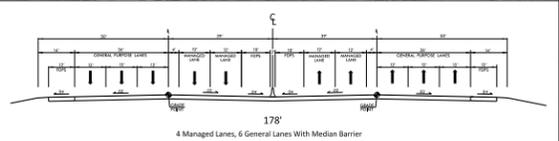
Durham

Research Triangle Park

CSX RR

LOWE'S GROVE MIDDLE SCHOOL
DURHAM COUNTY LIBRARY

TRIANGLE VILLAGE SHOPPING CENTER



I-40 FEASIBILITY STUDY



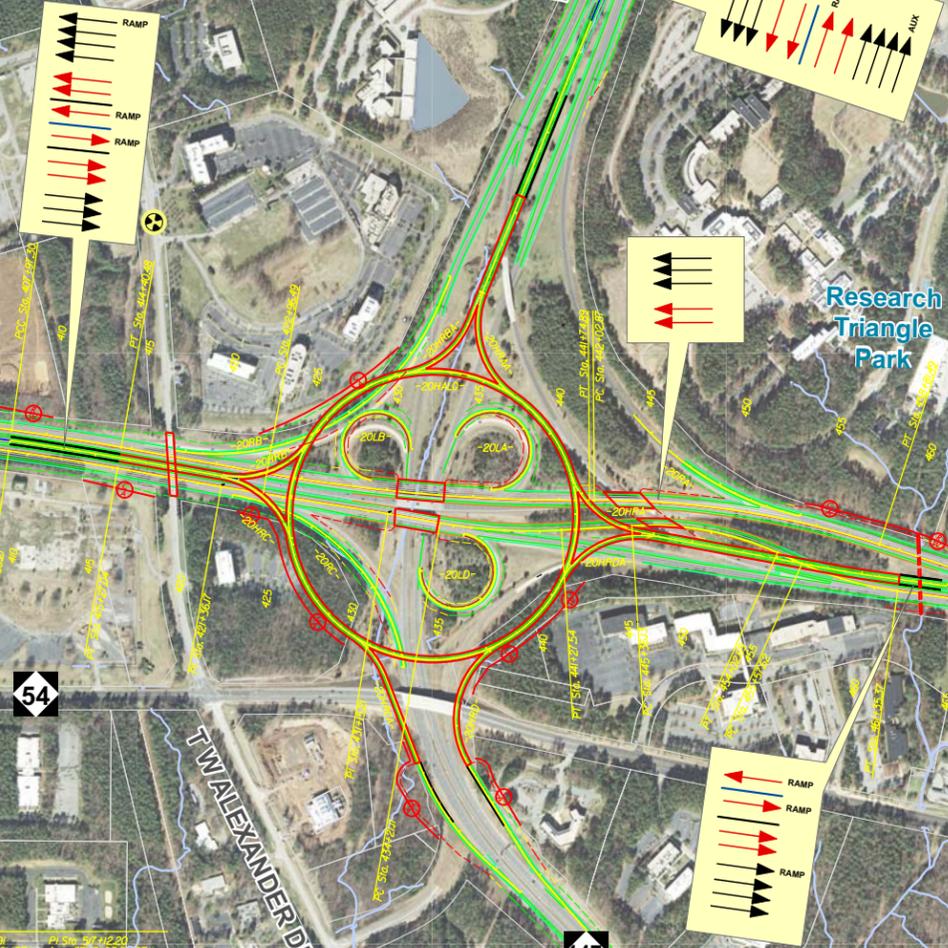
STIP PROJECT NO. FS-1205A
Orange, Durham, & Wake Counties

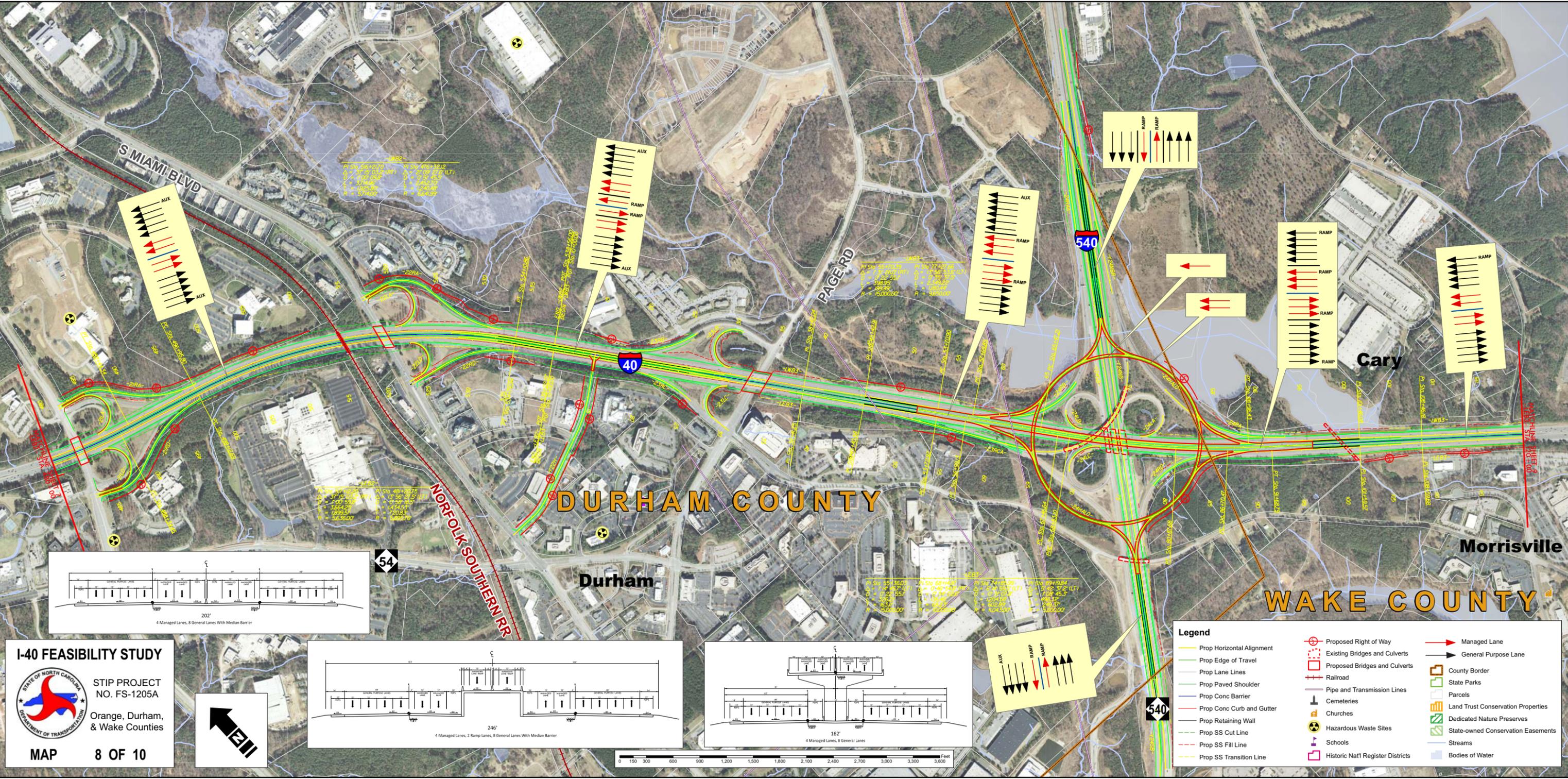
MAP 7 OF 10



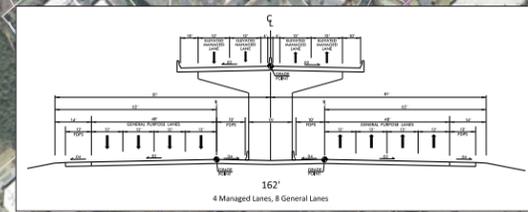
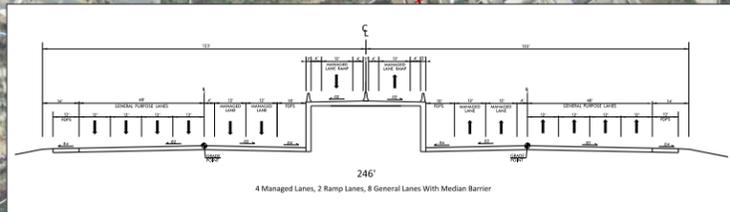
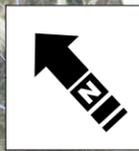
Legend	
	Prop Horizontal Alignment
	Prop Edge of Travel
	Prop Lane Lines
	Prop Paved Shoulder
	Prop Conc Barrier
	Prop Conc Curb and Gutter
	Prop Retaining Wall
	Prop SS Cut Line
	Prop SS Fill Line
	Prop SS Transition Line
	Proposed Right of Way
	Existing Bridges and Culverts
	Proposed Bridges and Culverts
	Railroad
	Pipe and Transmission Lines
	Cemeteries
	Hazardous Waste Sites
	Schools
	Historic Nat'l Register Districts
	Managed Lane
	General Purpose Lane
	County Border
	State Parks
	Parcels
	Land Trust Conservation Properties
	Dedicated Nature Preserves
	State-owned Conservation Easements
	Streams
	Bodies of Water

Technical data including stationing, PI, PVI, and curve information for various segments of the proposed highway.



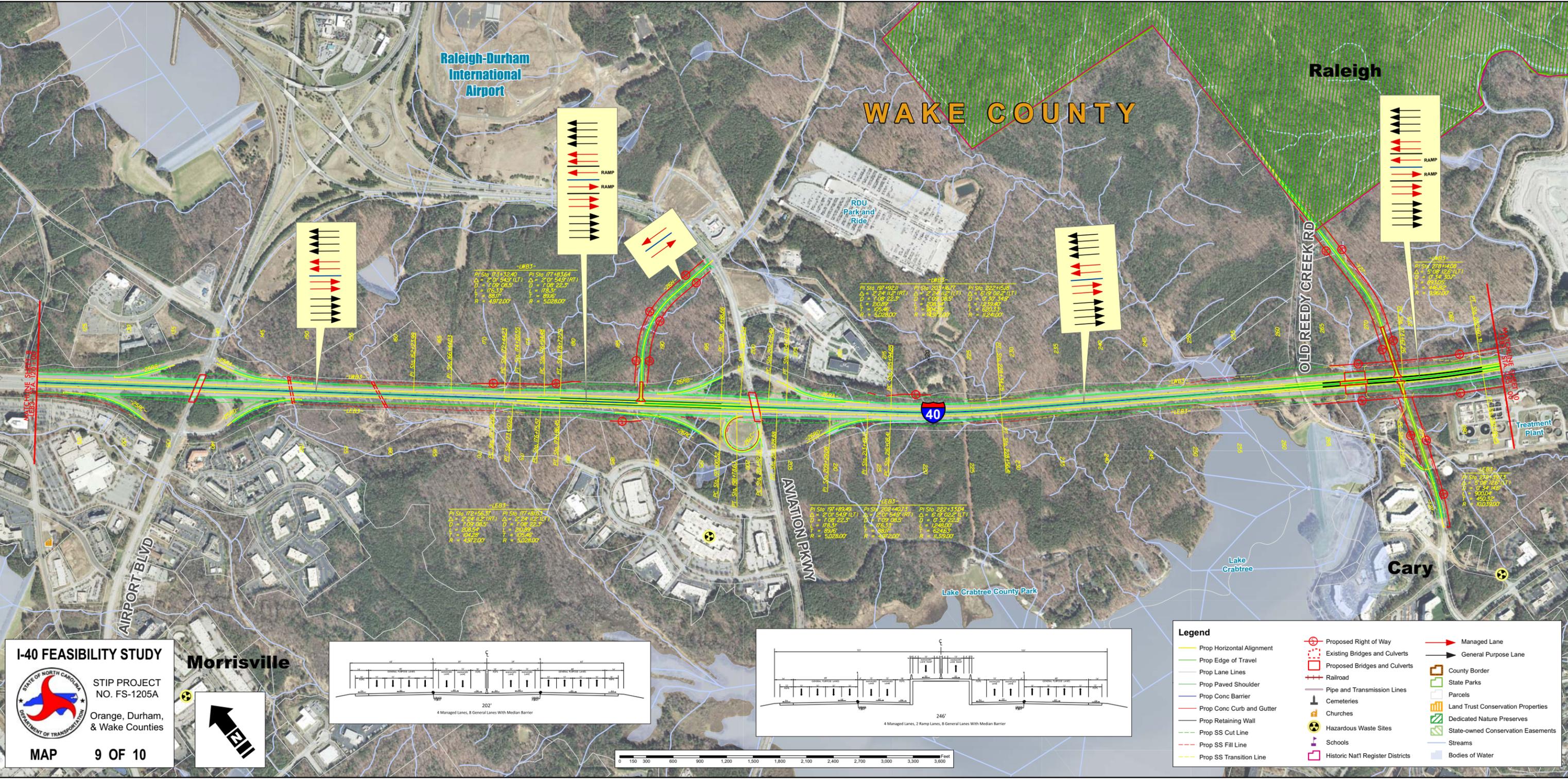


I-40 FEASIBILITY STUDY
 STIP PROJECT NO. FS-1205A
 Orange, Durham, & Wake Counties
 MAP 8 OF 10



Legend

Prop Horizontal Alignment	Existing Right of Way	Managed Lane
Prop Edge of Travel	Existing Bridges and Culverts	General Purpose Lane
Prop Lane Lines	Proposed Bridges and Culverts	County Border
Prop Paved Shoulder	Railroad	State Parks
Prop Conc Barrier	Pipe and Transmission Lines	Parcels
Prop Conc Curb and Gutter	Cemeteries	Land Trust Conservation Properties
Prop SS Fill Line	Churches	Dedicated Nature Preserves
Prop SS Transition Line	Hazardous Waste Sites	State-owned Conservation Easements
	Schools	Streams
	Historic Nat'l Register Districts	Bodies of Water



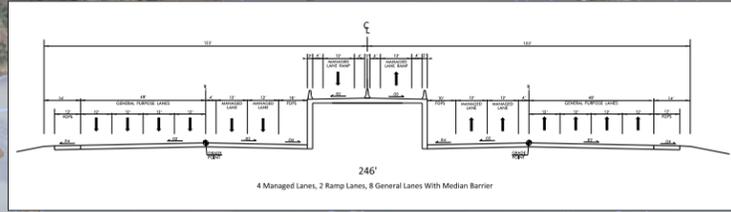
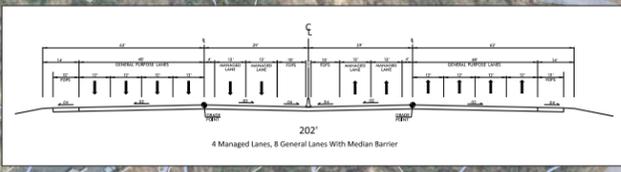
I-40 FEASIBILITY STUDY

STIP PROJECT NO. FS-1205A

Orange, Durham, & Wake Counties

MAP 9 OF 10

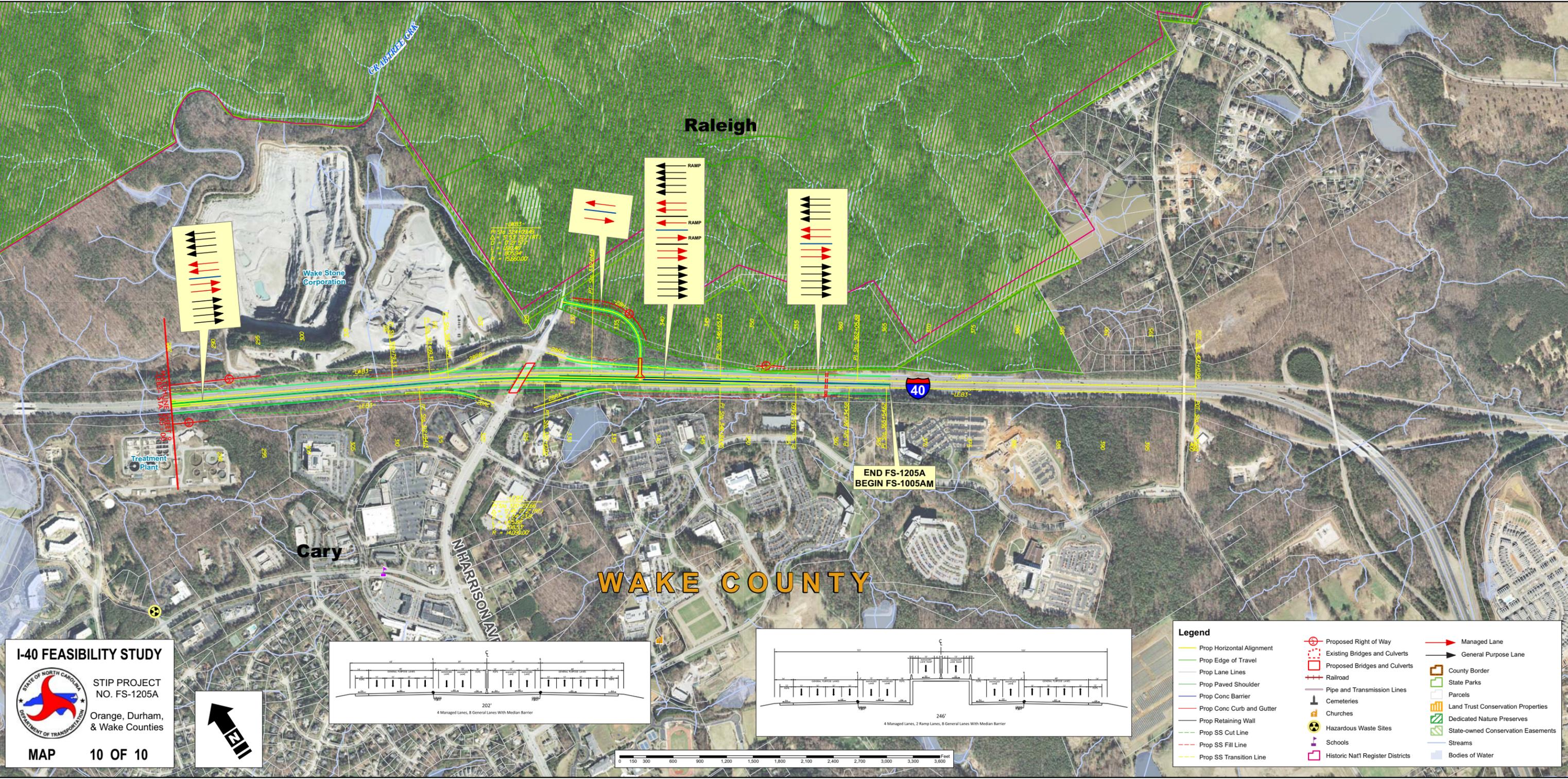
Morrisville



Legend

- Prop Horizontal Alignment
- Prop Edge of Travel
- Prop Lane Lines
- Prop Paved Shoulder
- Prop Conc Barrier
- Prop Conc Curb and Gutter
- Prop Retaining Wall
- Prop SS Cut Line
- Prop SS Fill Line
- Prop SS Transition Line
- Proposed Right of Way
- Existing Bridges and Culverts
- Proposed Bridges and Culverts
- Railroad
- Pipe and Transmission Lines
- Cemeteries
- Churches
- Hazardous Waste Sites
- Schools
- Historic Nat'l Register Districts
- Managed Lane
- General Purpose Lane
- County Border
- State Parks
- Parcels
- Land Trust Conservation Properties
- Dedicated Nature Preserves
- State-owned Conservation Easements
- Streams
- Bodies of Water



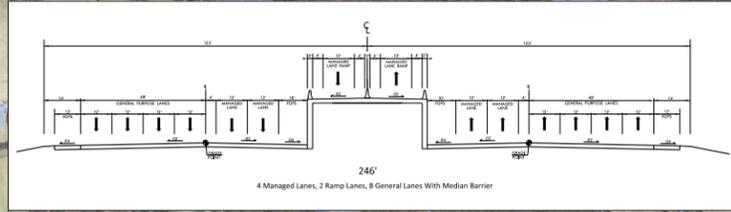
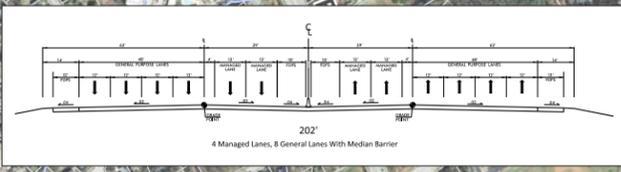


I-40 FEASIBILITY STUDY

STIP PROJECT NO. FS-1205A

Orange, Durham, & Wake Counties

MAP 10 OF 10



Legend

Prop Horizontal Alignment	Existing Bridges and Culverts	Managed Lane
Prop Edge of Travel	Proposed Bridges and Culverts	General Purpose Lane
Prop Lane Lines	Railroad	County Border
Prop Paved Shoulder	Pipe and Transmission Lines	State Parks
Prop Conc Barrier	Cemeteries	Parcels
Prop Conc Curb and Gutter	Churches	Land Trust Conservation Properties
Prop Retaining Wall	Hazardous Waste Sites	Dedicated Nature Preserves
Prop SS Cut Line	Schools	State-owned Conservation Easements
Prop SS Fill Line	Historic Nat'l Register Districts	Streams
Prop SS Transition Line		Bodies of Water

APPENDIX B

Local Government Comment Letters



CITY OF DURHAM

Transportation Department

101 CITY HALL PLAZA | DURHAM, NC 27704

919.560.4366 | F 919.560.4561

www.DurhamNC.gov

April 29, 2016

Lynnise M. Hawes, P.E.
NCDOT Feasibility Studies Unit
1534 Mail Service Center
Raleigh, NC 27699-1534

Dear Ms. Hawes:

The City of Durham has received the draft feasibility study for FS-1205A, I-40 Express Lanes from I-85 to Wade Avenue, and offers the following comments.

The Durham-Chapel Hill-Carrboro Metropolitan Planning Organization 2040 Metropolitan Transportation Plan includes managed lanes on I-40 between US 15/501 and Wade Avenue in Wake County (managed lanes continue further east in the Capital Area MPO). The project was assumed to be split into segments with the NC 147 to Wade Avenue segment being built first by 2030 and the US 15/501 to NC 147 segment being built second by 2040. Both segments only included the addition of one managed lane in each direction. Two managed lanes in each direction is not consistent with the 2040 MTP.

While we understand that NCDOT has a standard procedure for developing feasibility studies and generally the only projects that are assumed are committed projects in the current STIP, there are several other projects on I-40 that are likely to be implemented before a large and costly managed lanes project. For example, the widening of I-40 from I-85 to US 15/501 from four to six general purpose lanes and improvements to the US 15/501, NC 54, and NC 147 interchanges are priority projects that may be built before managed lanes. The City in coordination with NCDOT and the DCHC MPO would consider many other improvements to I-40 to address congestion and safety concerns before deciding to implement a more than \$1 billion managed lanes project. It would be useful if the feasibility study included a scenario with these other projects implemented first before managed lanes.

The feasibility study mentions Our Transit Future, the study of regional rail transit investment opportunities, on page 7. However, the study does not include current details on the Durham-Orange Light Rail Transit (DO LRT) project. The Federal Transit Administration (FTA) recently issued the Combined Final Environmental Impact Statement – Record of Decision for this project (<http://ourtransitfuture.com/feis-rod/>). The project is proposed to be located in the I-40 corridor in between US 15/501 and NC 54. In addition, the Rail Operations and Maintenance Facility is proposed to be located in between I-40 and Farrington Road. The DO LRT project was designed to be consistent with the 2040 MTP which includes one managed lane in each direction. The feasibility study's recommendation of two managed lanes in each direction is very likely in conflict with the recommended DO LRT project. There may be additional costs and environmental impacts

to accommodate this project. We advise that you contact GoTriangle staff for more information about the DO LRT project.

In addition, the table of STIP projects on page 8 needs to be updated to reflect the current STIP. U-5774 (NC 54 from I-40 to US 15/501) has funding but is not listed, and U-5324 (NC 54 from I-40 to NC 55) is listed but does not have funding (it is submitted for prioritization).

The managed lanes access point from Mt. Moriah Road will impact traffic on nearby roads and intersections such as the I-40 and US 15/501 interchange, the Mt. Moriah Road and US 15/501 intersection, and the Southwest Durham Drive and US 15/501 intersection. Improving these nearby intersections must be done before the managed lanes project is implemented. Bringing additional traffic through this area to access the managed lanes cannot be accommodated without improvements.

The proposed project does not include access to the managed lanes near NC 54. This is a major access point to I-40 for traffic from Chapel Hill and south Durham. As shown in the AADT table on page 4, the AADT changes by 26,000 at NC 54. This rivals the 27,000 changes at NC 147 and I-540 (freeway-to-freeway interchanges). It far exceeds the AADT changes at US 15/501, NC 86, and NC 751 which all are proposed to have managed lane access points. A DO LRT transit station with a large park-and-ride lot is proposed to be located near the NC 54 and I-40 interchange. It is imperative that the study include an access point to the managed lanes at NC 54.

Both proposed access points near NC 751 have merits. Access to/from Southpoint Mall currently causes congestion at Renaissance Parkway and NC 751 and at I-40 and Fayetteville Road. A direct access to Renaissance from I-40 would be helpful to accommodate mall traffic. However, it would not be convenient for vehicles from nearby neighborhoods in south Durham to need to go through the congested mall area to access the managed lanes. Non-mall traffic would be better accommodated by the proposed access point on NC 751. Both of these accesses have impacts to important environmental and community resources. The NC 751 access goes through US Army Corps of Engineers land, and the Renaissance access crosses through the American Tobacco Trail and a stormwater detention pond. Further study is needed to determine which access is better or if both accesses could be included.

The proposed access point from Miami Boulevard is very close to the NC 54 intersection. This would have significant negative impacts to the operation of this intersection. The access should be relocated further north to provide better spacing from existing intersections.

Considering the size and complexity of this project, it seems likely to be implemented in segments. Based on the analysis, a managed lane may not be worth the investment in the western segment of the project where the mainline is expected to operate below capacity. The feasibility study should include a breakdown of project costs by segment so we can consider different project limits and compare costs, impacts, and benefits.

The feasibility study should also include an estimate for a project that is consistent with our 2040 MTP with one managed lane in each direction that does not assume an ultimate condition of two managed lanes in each direction. This would be useful information to consider when we submit and prioritize this project in the TIP development process.

Implementing managed lanes in the Triangle will be a major undertaking with far-reaching impacts and benefits to the area. We appreciate NCDOT's development of a feasibility study as one of the first steps to considering a project of this magnitude. However, clearly there are many unanswered

questions and further analyses needed to develop a project. Please consider these comments on the draft feasibility study and we look forward to working more with NCDOT on this project. Please let me know if you have any questions about these comments.

Sincerely,

A handwritten signature in cursive script that reads "Ellen Beckmann".

Ellen Beckmann
Senior Transportation Planner

c: Harmon Crutchfield, Transportation
Wesley Parham, Transportation
Felix Nwoko, DCHC MPO
Andy Henry, DCHC MPO
Lindsey Smart, DCHC MPO
Dave Charters, GoTriangle
Patrick McDonough, GoTriangle